(12) UK Patent Application (19) GB (11) 2 359 185 (13) A

(43) Date of Printing by UK Office 15.08.2001

(21) Application No 0110173.2

(22) Date of Filing 26.10.1999

(30) Priority Data
(31) 10321437 (32) 27.10.1998 (33) JP
(31) 11120698 (32) 27.04.1999

(86) International Application Data
PCT/JP99/05922 Jp 26.10.1999

(87) International Publication Data
WO00/25312 Jp 04.05.2000

(51) INT CL⁷
G11B 20/10 // G11B 31/00

(52) UK CL (Edition S)
G5R RAC RHX

(56) Documents Cited by ISA
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JP 090046636 A JP 070225687 A JP 070201130 A
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(58) Field of Search by ISA
INT CL⁷ G11B 20/10 , H04N 5/915
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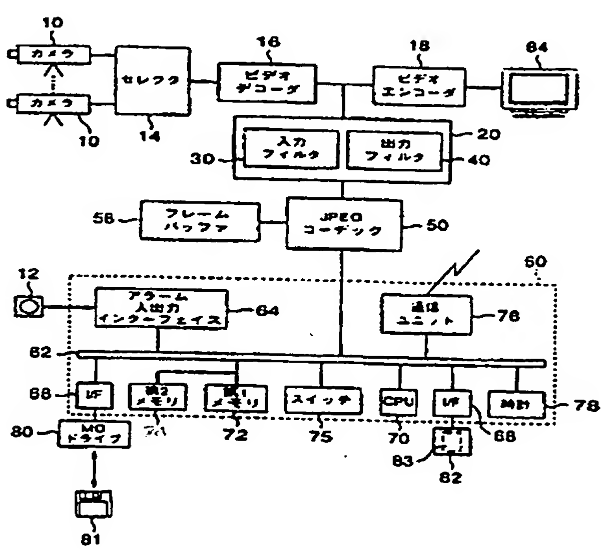
(54) Abstract Title

Information recording method and system, image compression/decompression system, system control method, and monitoring system including part or all of them

(57) A monitoring system excellent in creation, compression, decompression, and recording of image data, and system management compared to conventional one. To create image data, data deemed to be less important is thinned by executing a capturing command and by adjusting the compressibility of the codec, a differential coefficient measuring circuit and a lowpass filter is used for compression/decompression, a fixed disk and a removal disk are used together to avoid data loss due to exchange, and the system parameters and control program are automatically set and altered.



10 ... CAMERA
14 ... SELECTOR
16 ... VIDEO DECODER
18 ... VIDEO ENCODER
30 ... INPUT FILTER
40 ... OUTPUT FILTER
50 ... JPEG CODEC
58 ... FRAME BUFFER
64 ... ALARM INPUT/OUTPUT INTERFACE
72 ... FIRST MEMORY
74 ... SECOND MEMORY
75 ... SWITCH
76 ... COMMUNICATION UNIT
78 ... CLOCK
80 ... MO DRIVE

GB 2 359 185 A

FIG.1

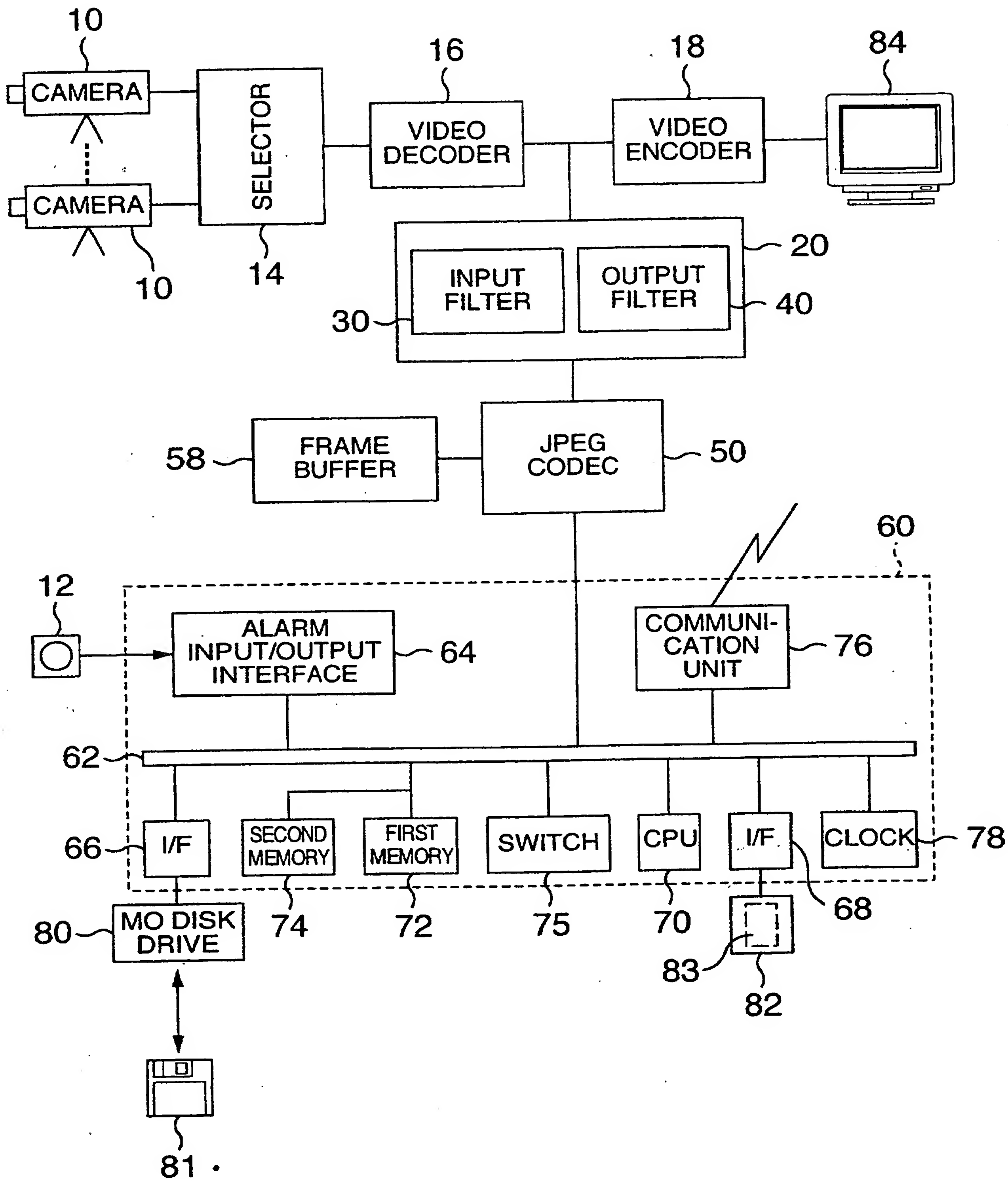

CAMERA
CAMERA
SELECTOR
VIDEO DECODER
VIDEO ENCODER
INPUT FILTER
OUTPUT FILTER
FRAME BUFFER
JPEG CODEC
ALARM INPUT/OUTPUT INTERFACE
COMMUNI-CATION UNIT
I/F
SECOND MEMORY
FIRST MEMORY
SWITCH
CPU
I/F
CLOCK
MO DISK DRIVE
10
10
12
14
16
18
20
30
40
50
58
60
62
64
66
68
70
72
74
75
76
78
80
81
82
83
84

FIG.2

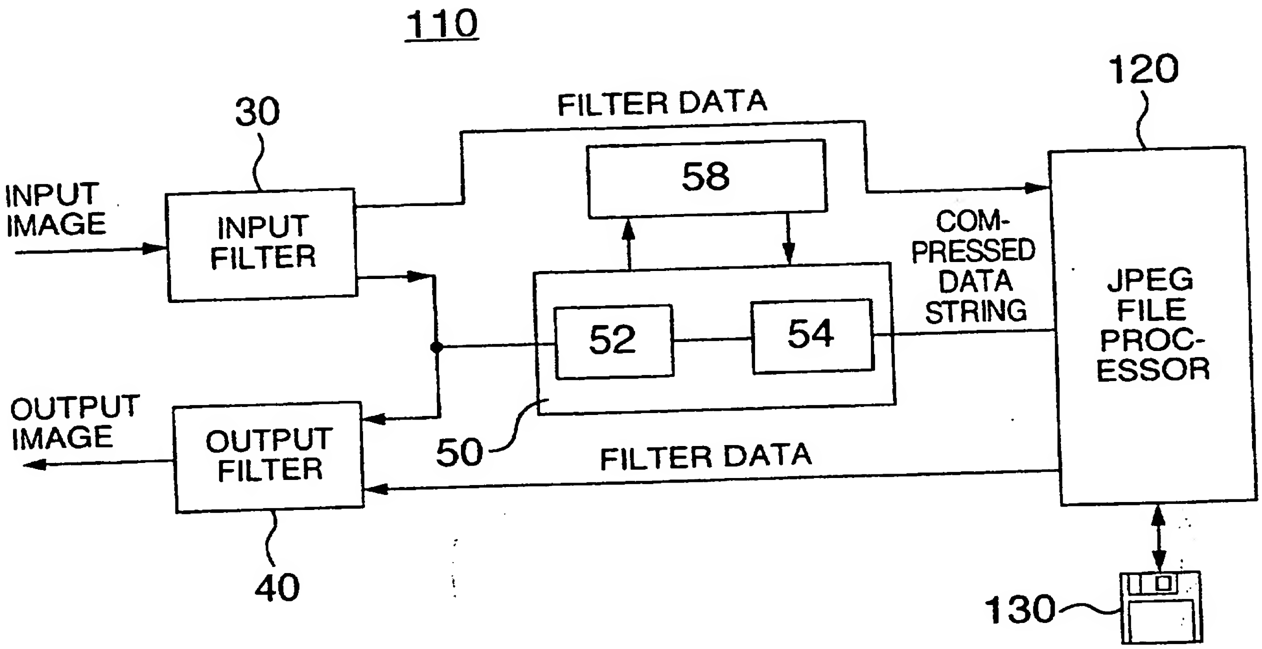

110
FILTER DATA
30
INPUT IMAGE
INPUT FILTER
58
120
COM-PRESSED DATA STRING
JPEG FILE PROC-ESSOR
52
54
OUTPUT IMAGE
OUTPUT FILTER
50
FILTER DATA
40
130

FIG.3

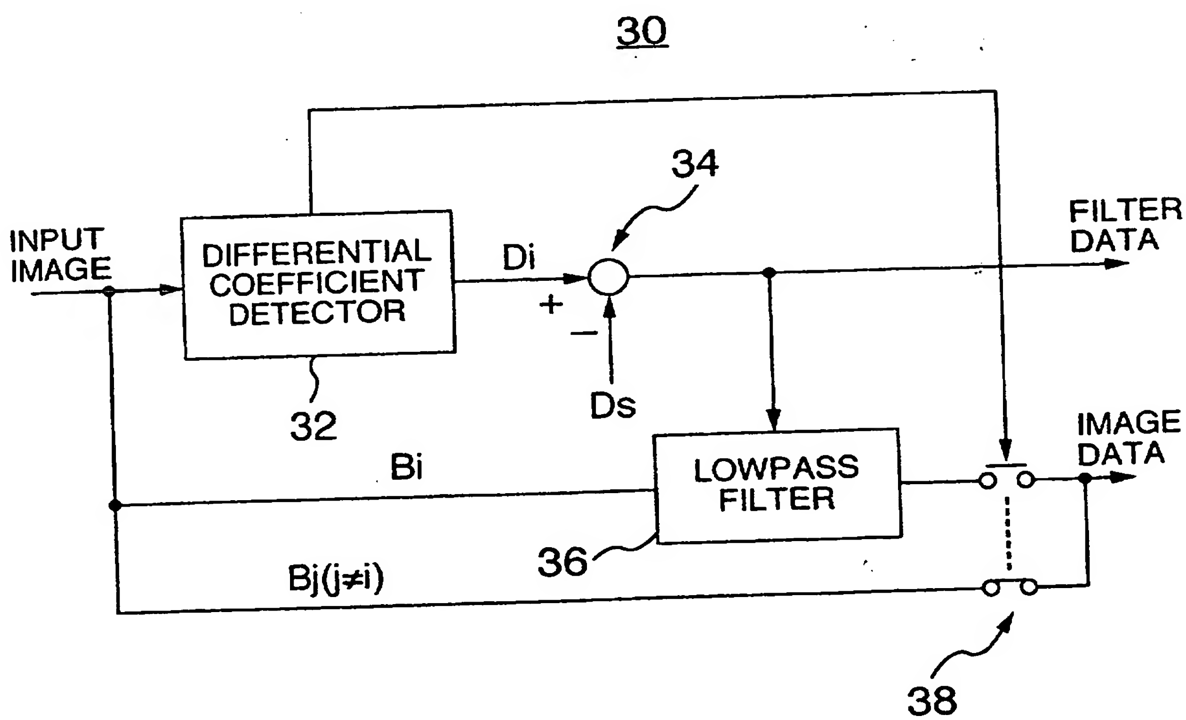

30
34
INPUT IMAGE
DIFFERENTIAL COEFFICIENT DETECTOR
Di
+
−
Ds
FILTER DATA
32
Bi
LOWPASS FILTER
IMAGE DATA
36
Bj(j≠i)
38

FIG.4

120

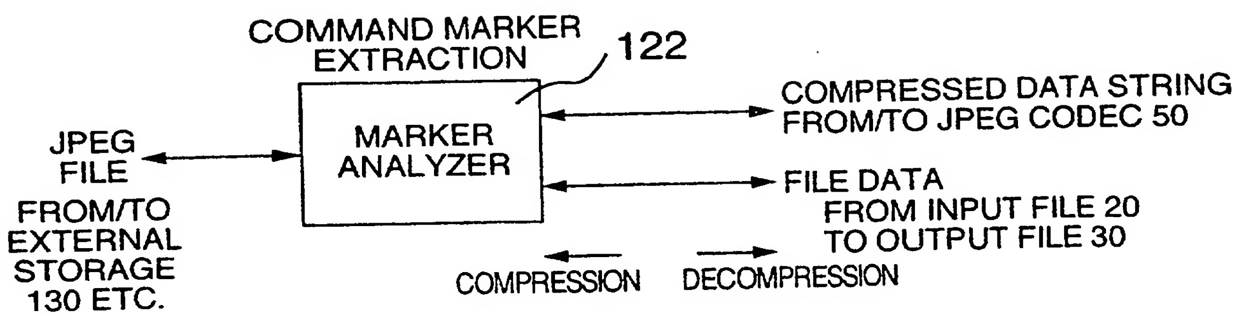


FIG.5

40

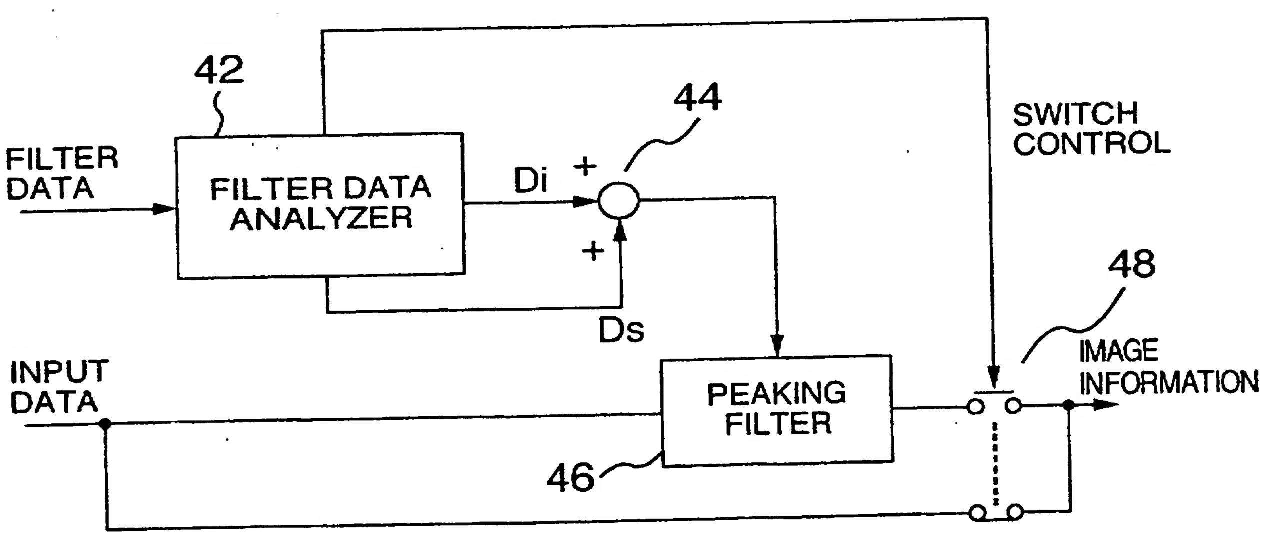


FIG.6

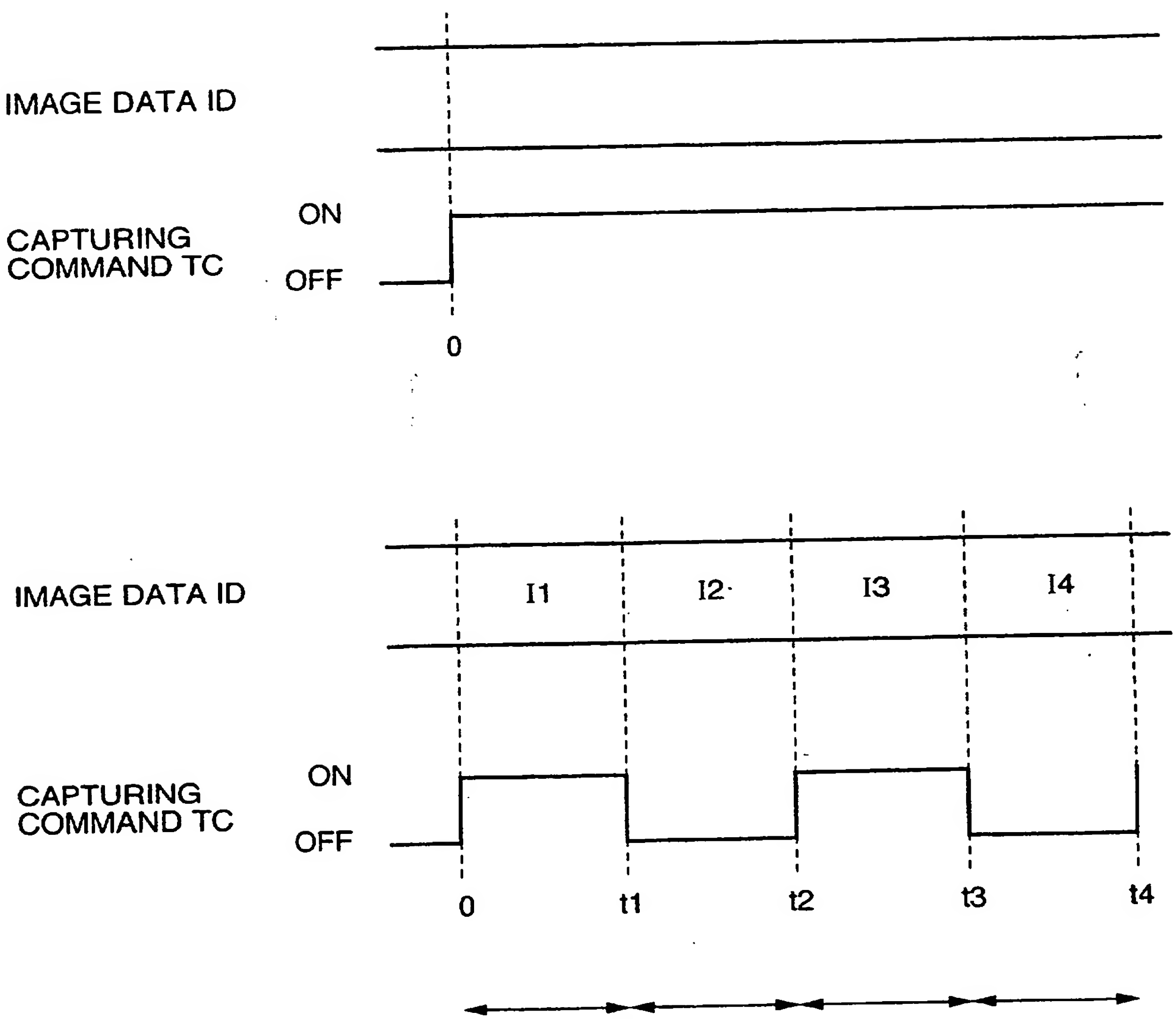


IMAGE DATA ID
CAPTURING COMMAND TC
ON
OFF
0
IMAGE DATA ID
I1
I2
I3
I4
CAPTURING COMMAND TC
ON
OFF
0
t1
t2
t3
t4

FIG.7

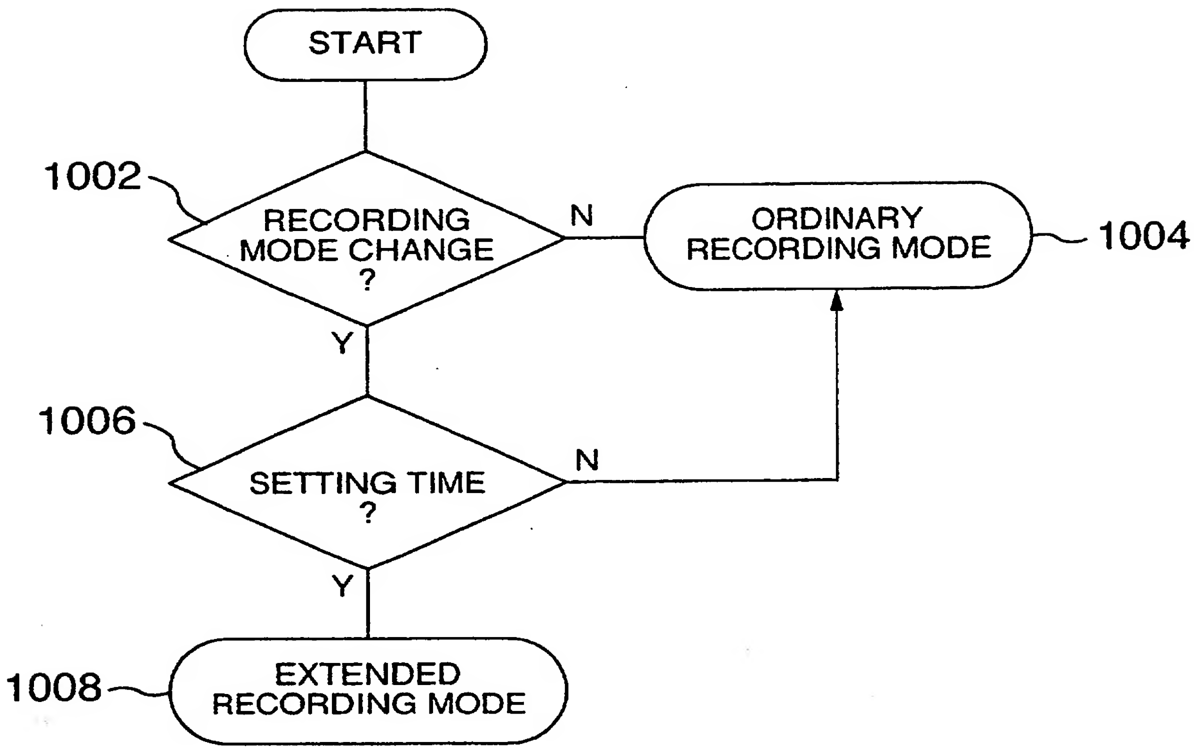

START
1002
RECORDING MODE CHANGE ?
N
Y
ORDINARY RECORDING MODE
1004
1006
SETTING TIME ?
N
Y
1008
EXTENDED RECORDING MODE

FIG.8

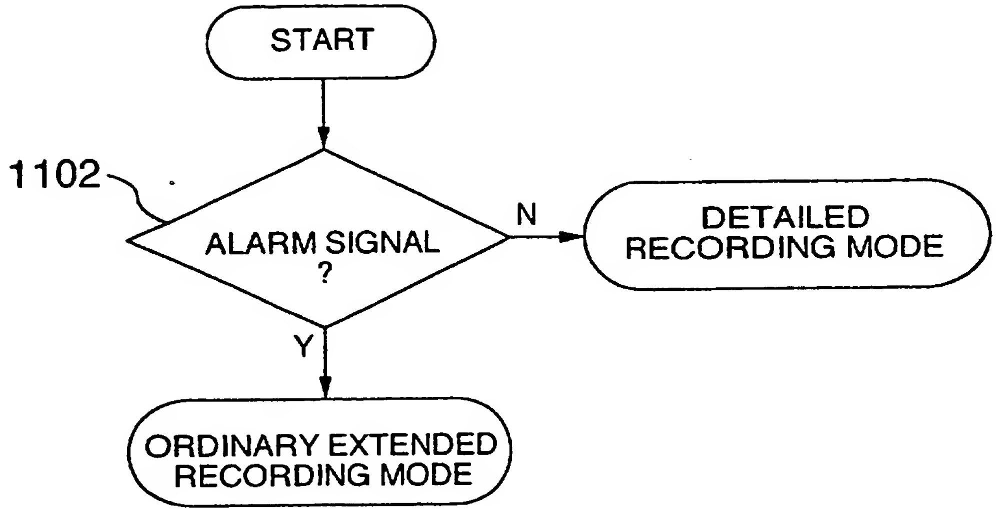

START
1102
ALARM SIGNAL ?
N
DETAILED RECORDING MODE
Y
ORDINARY EXTENDED RECORDING MODE

FIG.9

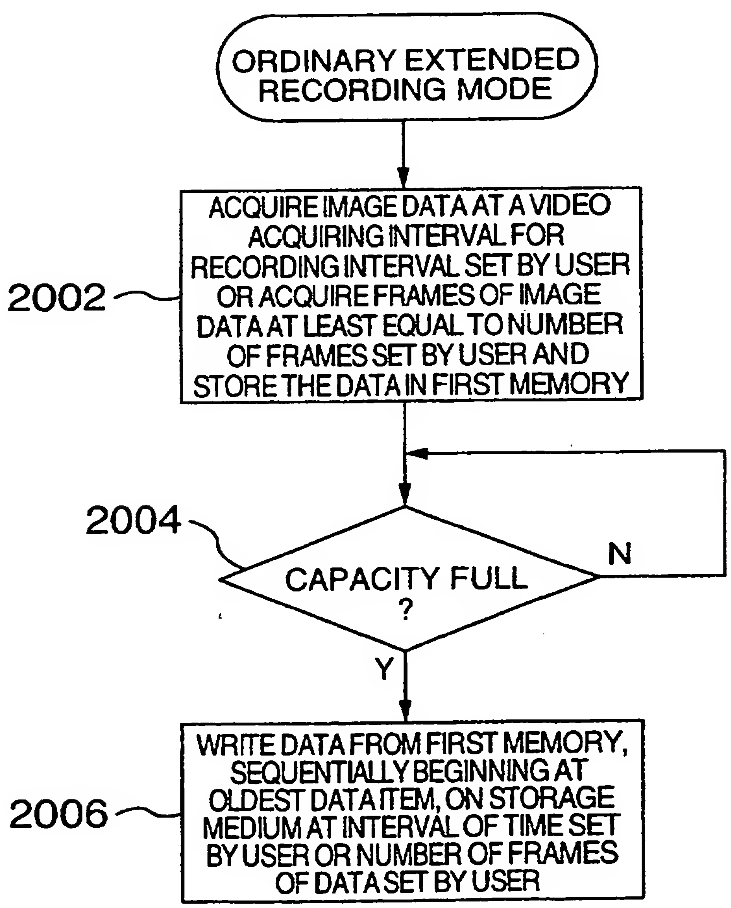

ORDINARY EXTENDED RECORDING MODE
2002
ACQUIRE IMAGE DATA AT A VIDEO ACQUIRING INTERVAL FOR RECORDING INTERVAL SET BY USER OR ACQUIRE FRAMES OF IMAGE DATA AT LEAST EQUAL TO NUMBER OF FRAMES SET BY USER AND STORE THE DATA IN FIRST MEMORY
2004
CAPACITY FULL ?
N
Y
2006
WRITE DATA FROM FIRST MEMORY, SEQUENTIALLY BEGINNING AT OLDEST DATA ITEM, ON STORAGE MEDIUM AT INTERVAL OF TIME SET BY USER OR NUMBER OF FRAMES OF DATA SET BY USER

FIG.10

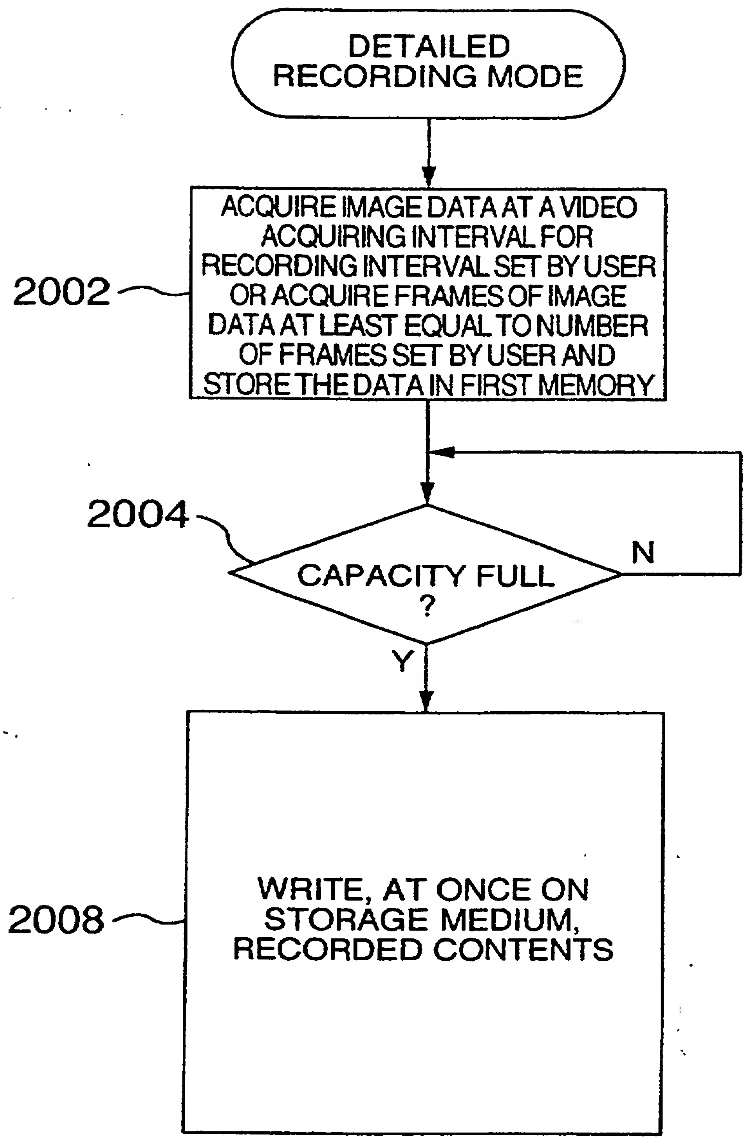

DETAILED RECORDING MODE
ACQUIRE IMAGE DATA AT A VIDEO ACQUIRING INTERVAL FOR RECORDING INTERVAL SET BY USER OR ACQUIRE FRAMES OF IMAGE DATA AT LEAST EQUAL TO NUMBER OF FRAMES SET BY USER AND STORE THE DATA IN FIRST MEMORY
2002
2004
CAPACITY FULL ?
N
Y
WRITE, AT ONCE ON STORAGE MEDIUM, RECORDED CONTENTS
2008

FIG.11

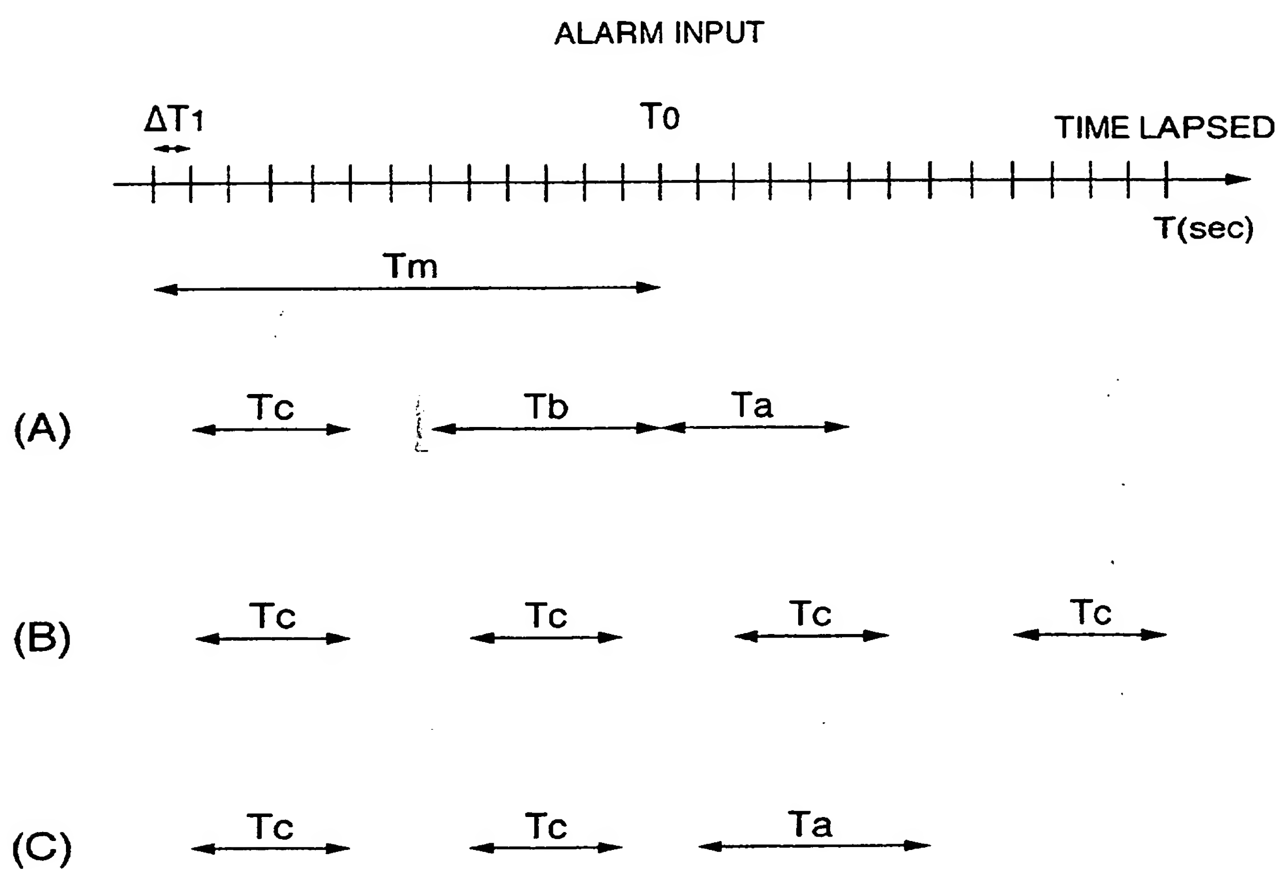

ALARM INPUT
ΔT1
T0
TIME LAPSED
T(sec)
Tm
(A)
Tc
Tb
Ta
(B)
Tc
Tc
Tc
Tc
(C)
Tc
Tc
Ta

FIG.12

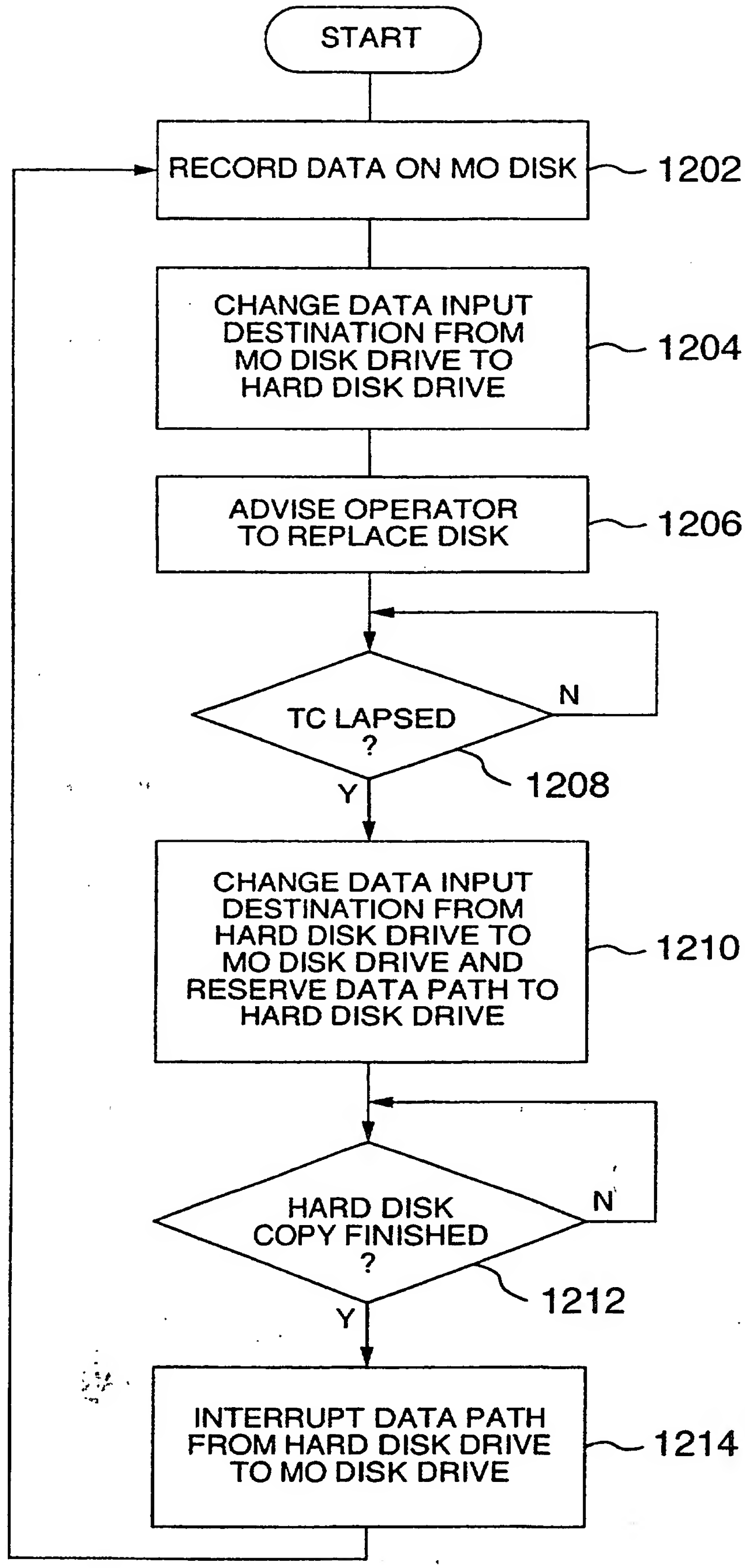

START
RECORD DATA ON MO DISK
1202
CHANGE DATA INPUT DESTINATION FROM MO DISK DRIVE TO HARD DISK DRIVE
1204
ADVISE OPERATOR TO REPLACE DISK
1206
TC LAPSED ?
N
Y
1208
CHANGE DATA INPUT DESTINATION FROM HARD DISK DRIVE TO MO DISK DRIVE AND RESERVE DATA PATH TO HARD DISK DRIVE
1210
HARD DISK COPY FINISHED ?
N
Y
1212
INTERRUPT DATA PATH FROM HARD DISK DRIVE TO MO DISK DRIVE
1214

FIG.13

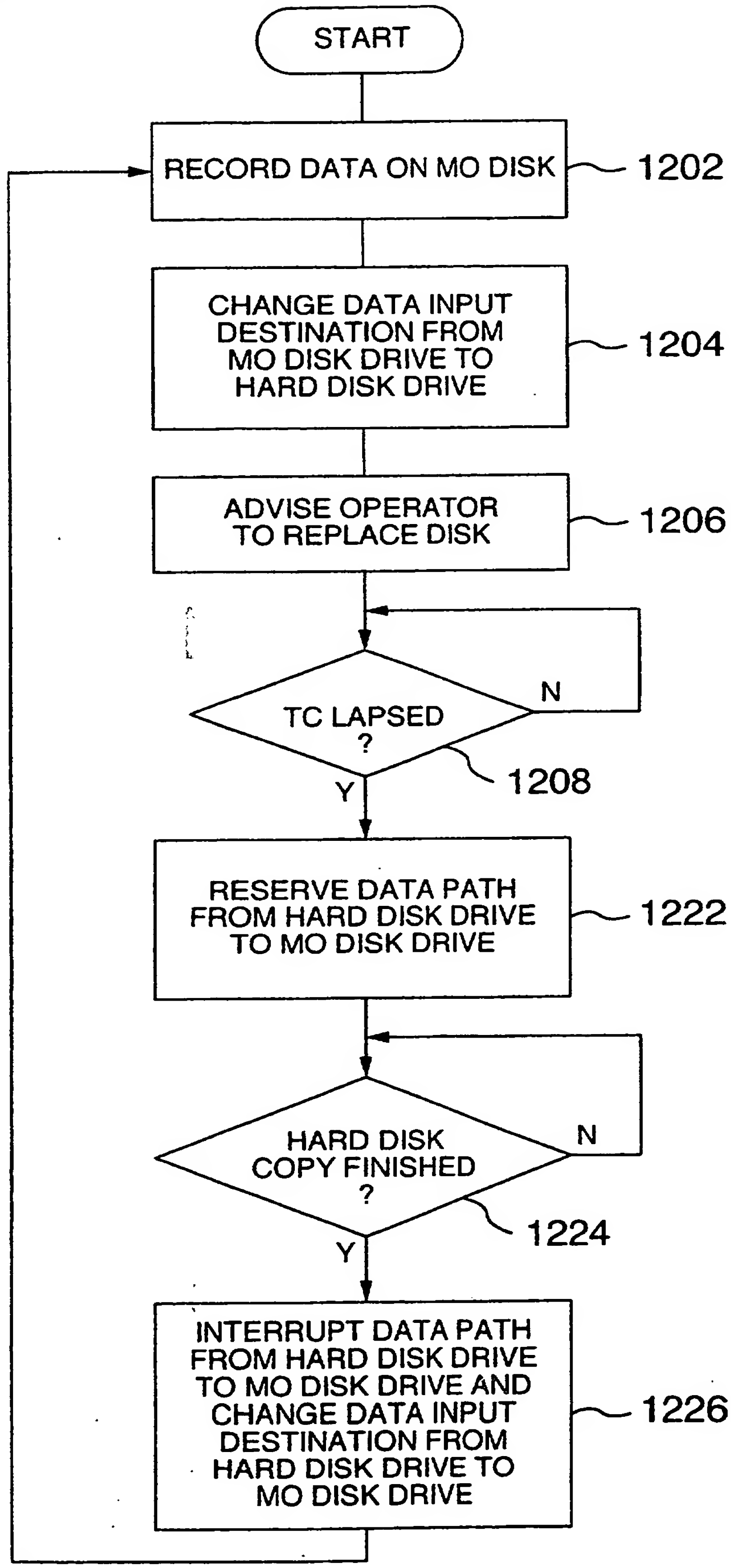

START
RECORD DATA ON MO DISK
1202
CHANGE DATA INPUT DESTINATION FROM MO DISK DRIVE TO HARD DISK DRIVE
1204
ADVISE OPERATOR TO REPLACE DISK
1206
TC LAPSED ?
N
Y
1208
RESERVE DATA PATH FROM HARD DISK DRIVE TO MO DISK DRIVE
1222
HARD DISK COPY FINISHED ?
N
Y
1224
INTERRUPT DATA PATH FROM HARD DISK DRIVE TO MO DISK DRIVE AND CHANGE DATA INPUT DESTINATION FROM HARD DISK DRIVE TO MO DISK DRIVE
1226

FIG.14

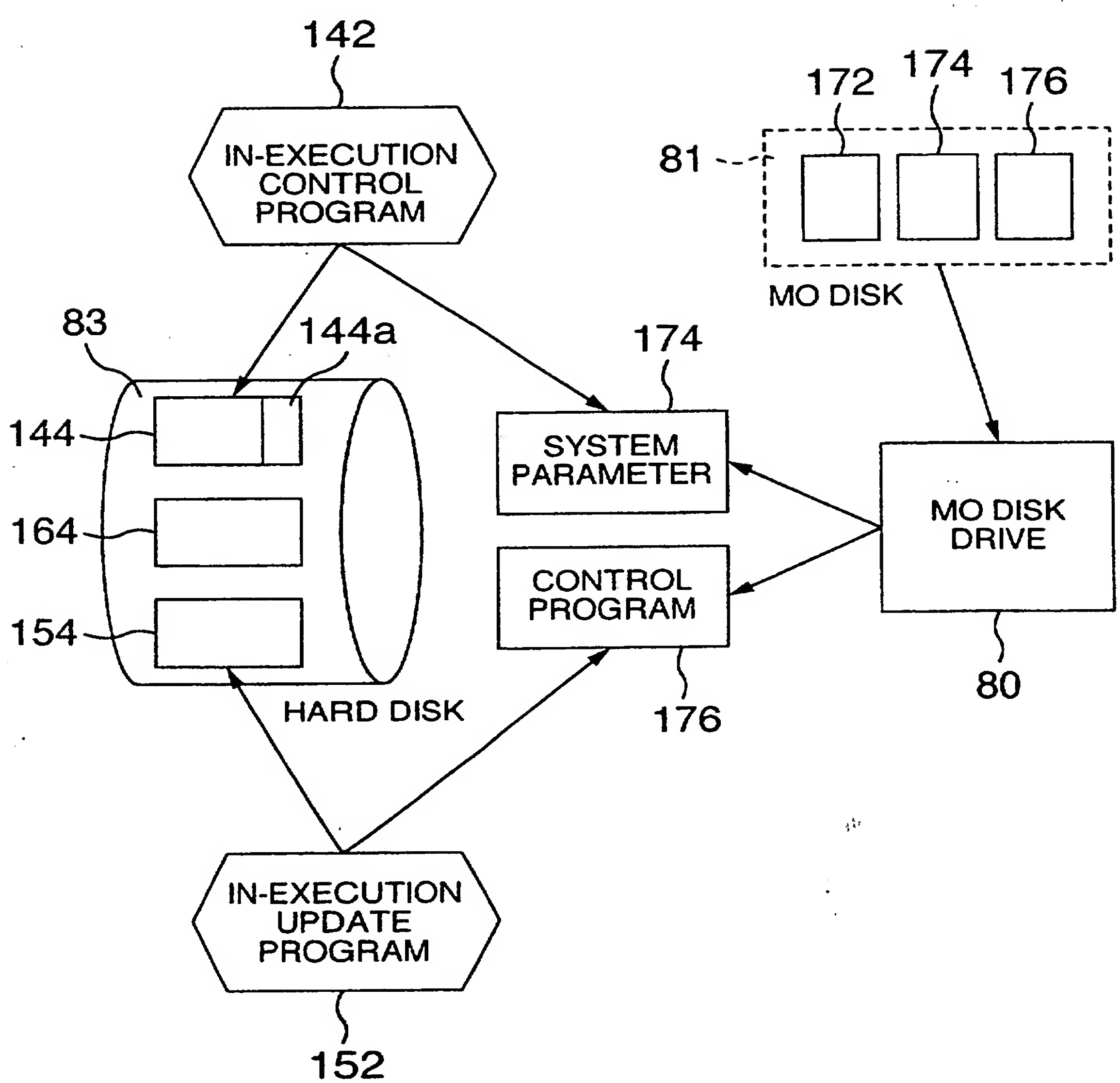

142
IN-EXECUTION CONTROL PROGRAM
172
174
176
81
MO DISK
83
144a
144
164
154
HARD DISK
174
SYSTEM PARAMETER
CONTROL PROGRAM
176
MO DISK DRIVE
80
IN-EXECUTION UPDATE PROGRAM
152

FIG.15

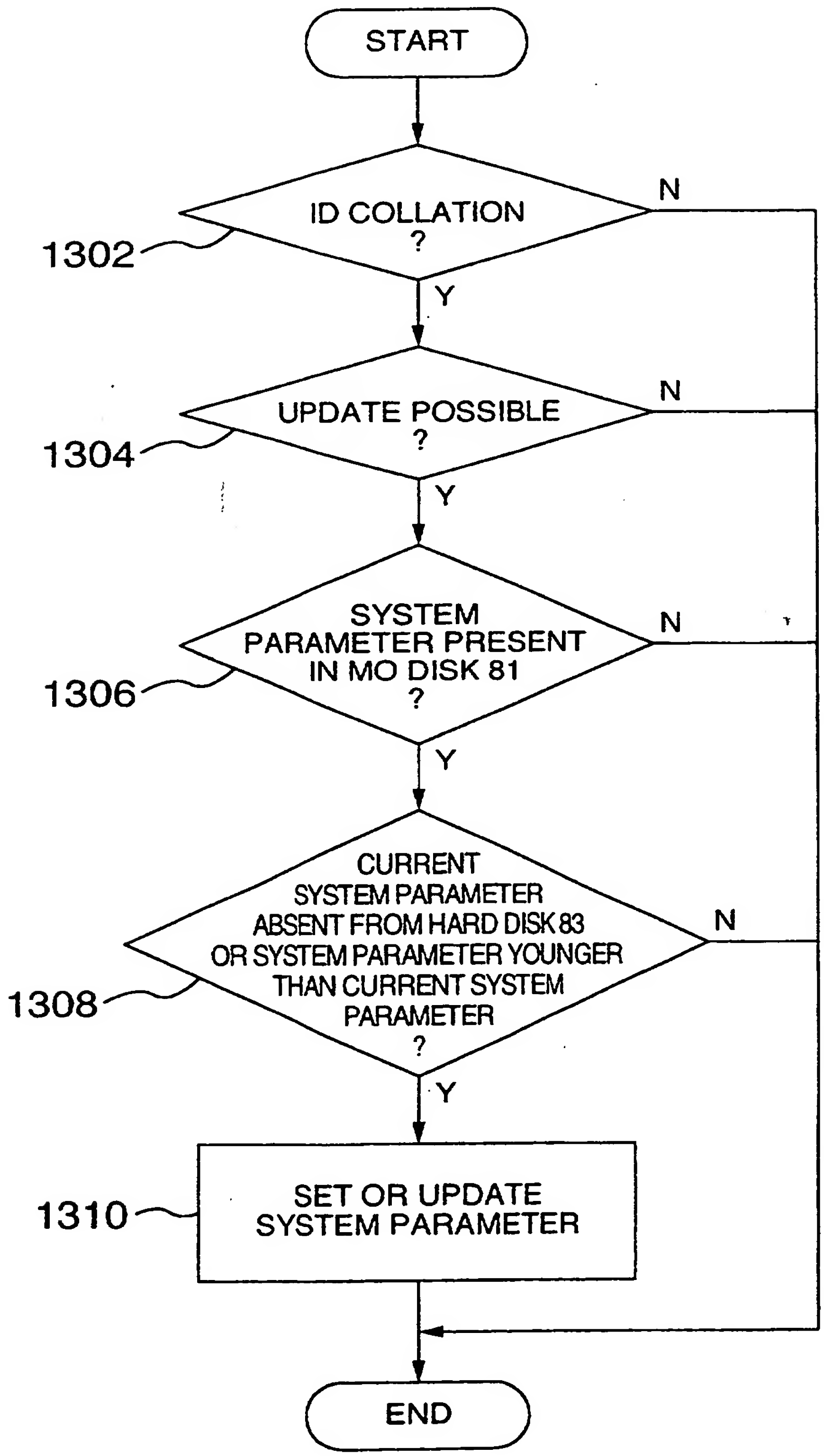
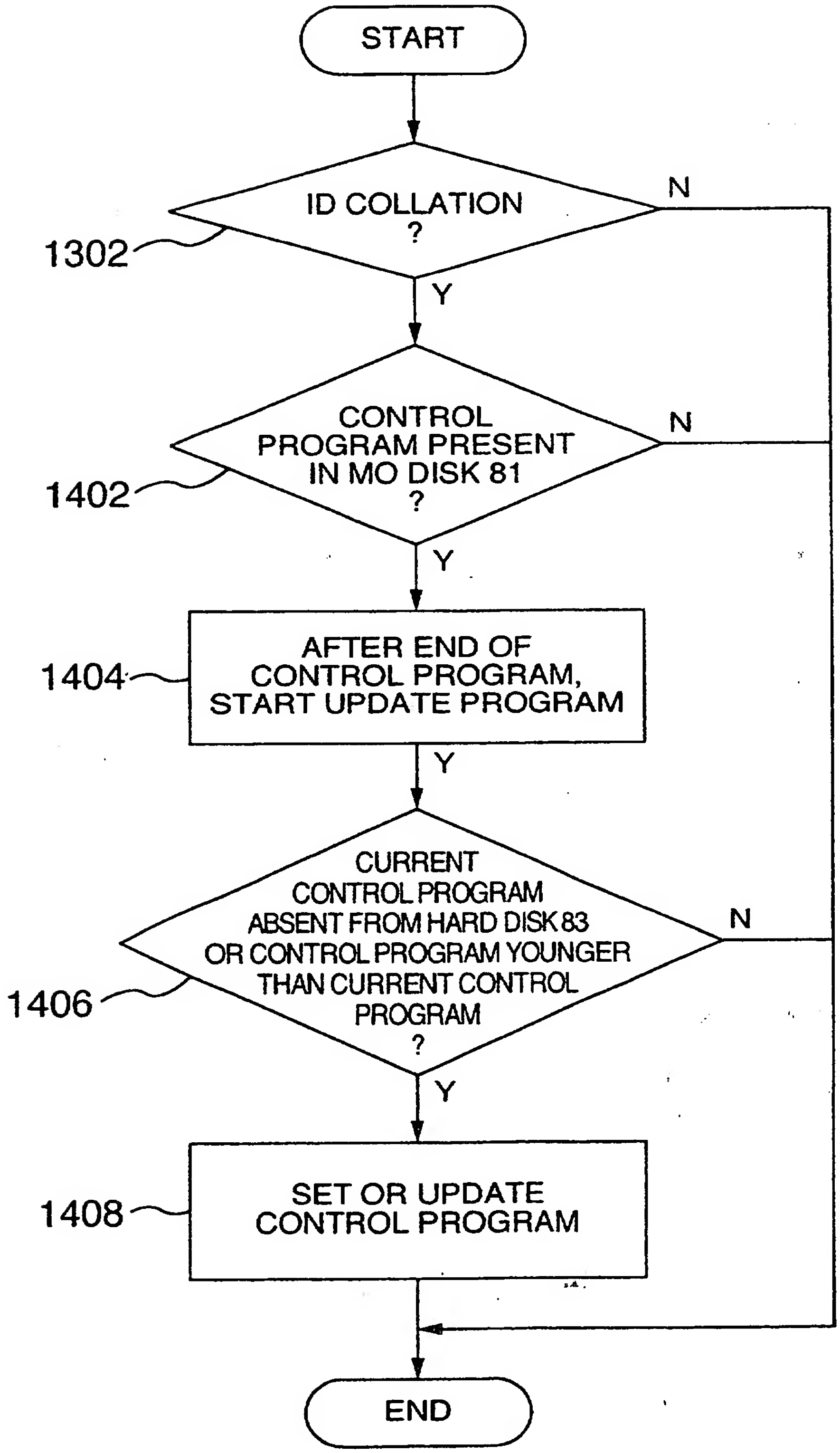

START
ID COLLATION ?
1302
N
Y
UPDATE POSSIBLE ?
1304
N
Y
SYSTEM PARAMETER PRESENT IN MO DISK 81 ?
1306
N
Y
CURRENT SYSTEM PARAMETER ABSENT FROM HARD DISK 83 OR SYSTEM PARAMETER YOUNGER THAN CURRENT SYSTEM PARAMETER ?
1308
N
Y
SET OR UPDATE SYSTEM PARAMETER
1310
END

FIG.16


START
ID COLLATION ?
N
1302
Y
CONTROL PROGRAM PRESENT IN MO DISK 81 ?
N
1402
Y
AFTER END OF CONTROL PROGRAM, START UPDATE PROGRAM
1404
Y
CURRENT CONTROL PROGRAM ABSENT FROM HARD DISK 83 OR CONTROL PROGRAM YOUNGER THAN CURRENT CONTROL PROGRAM ?
N
1406
Y
SET OR UPDATE CONTROL PROGRAM
1408
END

DESCRIPTION

INFORMATION RECORDING METHOD AND SYSTEM, IMAGE COMPRESSION/DECOMPRESSION SYSTEM, SYSTEM CONTROL METHOD, AND SURVEILLANCE SYSTEM INCLUDING PART OR ALL OF THEM

TECHNICAL FIELD

The present invention relates to an information recording method, an information recording system, an image compression/decompression system, a system control method, and a surveillance system including part or all of them.

Specifically, the present invention first relates to an information recording method, an information recording system, and in particular, to a method of and a system for recording digital signals in a continuous way, an intermittent way, and/or a time-sequence way. For example, the present invention relates to a control operation in a case in which while a large amount of data is being received at a fixed transfer rate, the data is continuously recorded in removable recording medium without interrupting a flow of the data. The information recording method and the information recording system according to the present invention are particularly suitable for a surveillance system in which predetermined places are continuously monitored by surveillance video cameras and digital

image signals resultantly produced by the surveillance video cameras are recorded in a storage.

Additionally, the present invention relates to image compression and decompression to transfer data at a high speed, and in particular, to image compression and decompression using a joint photographic experts group (JPEG) compression/decompression algorithm. The image compression/decompression system of the present invention is particularly suitable for data compression and decompression or defrosting in a situation in which information items/item of a photo shot by a camera with high resolution, an animation, letters of printing types, an image with high contrast such as a test pattern used before an actual television program, and/or an image containing abrupt changes in its contour are/is recorded in an external recording unit such as a magnetooptical (MO) disk are/is transferred via the internet or a leased line to another system at a remote place. Therefore, the image compression/decompression system of the present invention is also applicable to the surveillance system.

Furthermore, the present invention relates to a system control method and, in particular, to an automatic setting and update method for system parameters and control programs in the surveillance system.

BACKGROUND ART

There has been broadly used a surveillance system in which an alarm signal and image information sent from video cameras (surveillance cameras) arranged for crime prevention in a bank, a convenience store, a department store, and the like are received and are recorded in a facility installed in a security guaranteeing center at a remote location. Heretofore, there has been widely used a time laplace video tape recorder (VTR) to record analog data outputted from surveillance cameras. However, the recent surveillance system has a tendency to adopt, in place of the time laplace VTR, a surveillance camera digital recording/replay unit in which digital image data of an object shot by the surveillance camera is directly recorded as digital data. The surveillance camera digital recording/replay unit has a feature that the unit is superior, in the keeping and editing of high-quality images without deterioration of the quality with lapse of time, to the time laplace VTR of the prior art.

To transfer digital image data at a high speed, the prior art has typically proposed a JPEG compression/decompression algorithm. The JPEG compression/decompression algorithm conducting a sequential discrete cosine transformer (DCT) operation is based on ISO/IEC10918-1 (JPEG standard), and is an

algorithm which converts (compresses) still picture data into a smaller amount of data and which restores (defrosts or decompresses) the data into the original image data. The algorithm makes it possible to transfer a large amount of images in general at a high speed.

In the sequential DCT operation, a point of image data and another point quite near the point are assumed to be equal or similar in data to each other. By achieving a Fourier transform for a scalar quantity of a point of an image to convert the scalar quantity into a power spectrum along a frequency axis, any power spectrum at a frequency equal to or more than a particular frequency can be regarded as zero. By regarding the spectrum as zero, particular data is removed, which corresponds to "compression". Therefore, when a data string compressed by the sequential DCT operation is expanded, the original image is not completely replayed, that is, the decompressed data includes a loss.

In some surveillance systems, it is required to record all information sent from surveillance cameras continuously, for example, 24 hours per day and 365 days per year. Recently, removable recording medium such as a magnetooptical disk has been generally employed as a recording medium for a surveillance system because of its portability and large capacity (e.g., of 640 megabytes). For example, by replacing a

disk in such a surveillance system, it is theoretically possible to record an infinite data capacity.

However, in the disk replacement, even if the operator rapidly conducts the replacement, the continuous recording is interrupted for a period of time of the replacement. Therefore, in a surveillance system employing only one magnetooptical disk drive, an event in which important information to identify a suspicious person is not recorded may possibly take place. In this situation, to prevent an event in which potentially important information is not recorded even for a short period of time, two magnetooptical disk drives and a switching circuit are ordinarily arranged in the surveillance system of the prior art. The switching circuit first connects input image information to a first magnetooptical disk drive to record image data on a magnetooptical, activates a second magnetooptical disk drive immediately before the recording capacity of the magnetooptical disk of the first magnetooptical disk drive is used up, and then changes the input image data to the second magnetooptical disk drive to record succeeding image data on a second magnetooptical disk. Moreover, while the second magnetooptical disk drive is recording image data, the magnetooptical disk in the first magnetooptical disk drive is replaced with a new magnetooptical disk, and the processing is repeatedly executed. As above, by employing two magnetooptical

disk drives, the surveillance system of the prior art prevents interruption of the continuous recording.

DISCLOSURE OF INVENTION

However, the surveillance camera digital recording and replay unit has a larger number of environment setting items than the time laplace VTR of the prior art. That is, the digital recording and replay unit has various system parameters (i.e., system operation setting items) including an image compression ratio, a recording interval of frame, an alarm recording time, and a camera channel switching interval, and hence it is complex and troublesome to manually conduct a setting operation (setup) and an update operation (update) for the system parameters by operating the button and the like. Particularly, in a department store using a large number of surveillance camera digital recording and replay units, it is not efficient to repeatedly conduct the same operation for all units, and setting errors may easily take place. This also applies to control programs to control system parameters.

Moreover, in the surveillance system aiming at the continuous recording operation using removable recording medium, there can be considered as above to use to removable recording medium drives. However, the removable recording medium drive is in general expensive and hence installation of two removable

recording medium drives soars the cost of the surveillance system. Additionally, to install particularly two external removable recording medium drives, a large installing place must be reserved, which is inconvenient. Furthermore, when the user does not replace the magnetooptical disk, there occurs an event in which important information to identify a suspicious person or the like is not recorded. That is, when the user does not install a magnetooptical disk in the second magnetooptical disk drive before the recording capacity of the magnetooptical disk in the first magnetooptical disk drive is completely used up, image data is not recorded as a result from when the recording capacity of magnetooptical disk in the first magnetooptical disk drive is completely used up to when a magnetooptical disk is installed in the second magnetooptical disk drive. Assume, for example, that one magnetooptical disk can record 24 hours of image data. When 24 hours lapse after the recording of data on the pertinent magnetooptical disk is started, image data cannot be recorded thereon. That is, image data is not recorded until the magnetooptical disk is replaced with a new magnetooptical disk.

In addition, a certain type of loss associated with the sequential DCT operation is so conspicuous to give a sense of incongruity to eyes of a human. That is, according to the DCT operation, when a part of image data in which the differential

coefficient abruptly changes for similarity to the Fourier transform (for example, a part of image containing letters of printing types or a part of an abrupt rising section of the differential coefficient) is compressed and the compressed data is replayed to an image, a ghost image which is not actual image appears in a part of the image corresponding to the abrupt change of the differential coefficient. The ghost image is called "mosquito noise", which is a type of loss in consideration of quality deterioration of the replayed image. Since occurrence of the mosquito noise is a problem unique to the JPEG compression/decompression algorithm, it may be considered to develop another algorithm. However, a codec to implement the JPEG compression/decompression algorithm for the DCT operation is assumed as an inexpensive large-scale integration (LSI) circuit by many companies and firms. To change the codec or to manufacture a new LSI circuit increases the cost of the entire system. To prevent the increase of the cost, it is desirable to use an LSI chip for the JPEG codec available in the market at present.

As above, the surveillance system of the prior art has not a sufficient configuration in consideration of the creation, compression, decompression, and recording of image data and the system management.

It is therefore a general and exemplary

object of the present invention to provide a novel and useful continuous recording method, a novel and useful continuous recording system, a novel and useful image compression/decompression system, a novel and useful system control method, and a surveillance system using the method including part or all of them to solve the problem of the prior art.

An object of the present invention is to provide a surveillance system and a surveillance method capable of recording information even when the user forgets the replacing of a disk.

Another object of the present invention is to provide a surveillance system and a surveillance method capable of recording image data after a lapse of a predetermined recording period of time.

Further another object of the present invention is to provide a surveillance system and a surveillance method capable of replay a image recorded in the past even during a recording operation.

Still another object of the present invention is to provide a surveillance system and a surveillance method capable of recording a monitor image even during a replay operation of a recorded image.

In addition, another exemplary object of the present invention is to provide an information recording method and an information recording system capable of recording image data in a time zone in which image data cannot be recorded in the prior art and a

surveillance system using the information recording method.

Furthermore, another object of the present invention is to provide an image compression/decompression system in which while using a JPEG codec available at present, the mosquito noise is minimized to obtain higher picture quality as compared with the prior art and a surveillance system using the image compression/decompression system.

Additionally, another exemplary object of the present invention is to provide a system control method and a surveillance system using the system control method in which in the setting and update of the system parameters and the control programs, a duplicated manual operation and mistakes of the user in the manual operation are prevented to construct a highly reliable system.

To achieve the object in accordance with the present invention, there is provided a continuous recording system, comprising removable recording medium drive, a fixed disk unit, and a controller connected to said removable recording medium drive and said fixed disk unit, wherein said controller controls operation such that data is inputted to said removable recording medium drive an is recorded in removable recording medium of said removable recording medium drive; an input of said data is changed, when said removable recording medium is replaced with a new removable

recording medium, from said removable recording medium to said fixed disk unit and the data is recorded on a fixed disk of said fixed disk unit; and the data recorded on said fixed disk is transferred, after said removable recording medium is replaced, to said new removable recording medium, thereby continuously recording the data.

Moreover, a continuous recording method in accordance with the present invention comprises the first step of inputting data to removable recording medium drive and recording the data in removable recording medium of said removable recording medium drive, the second step of changing an input of the data from said removable recording medium to said fixed disk unit before an available memory capacity of said removable recording medium is used up, replacing said removable recording medium; and recording the data on a fixed disk of said fixed disk unit; the third step of changing the input of the data, after said removable recording medium is replaced with a new removable recording medium, from said fixed disk unit to said removable recording medium drive, recording the data in said new removable recording medium, reserving a data path from said fixed disk unit to said removable recording medium drive, and copying the data recorded on said fixed disk onto said removable recording medium; and the fourth step of interrupting, after the data recorded on said fixed disk is entirely copied

onto said removable recording medium, the data path from said fixed disk unit to said removable recording medium drive while keeping the input of data to said removable recording medium drive reserved, wherein control of process is returned to said first step to repetitiously execute processing.

Furthermore, the third and fourth steps may be replaced with the third step of reserving, after said removable recording medium is replaced, a data path from said fixed disk unit to said removable recording medium drive while keeping the input of data to said fixed disk unit reserved; and copying the data recorded on said fixed disk onto said removable recording medium in a time series fashion and the fourth step of changing the input of the data from said fixed disk unit to said removable recording medium drive after the data recorded on said fixed disk is entirely copied onto said removable recording medium, and interrupting the data path from said fixed disk unit to said removable recording medium drive. After the fourth step, control of process may be returned to the first step to repetitiously execute processing.

Additionally, a surveillance system in accordance with the present invention comprises a surveillance camera, a video decoder connected to said surveillance camera, an image compressor/decompressor connected to said video decoder, a video encoder connected to said image compressor/decompressor, a

display connected to said video encoder, and a continuous recording system connected to said image compressor/decompressor, wherein said continuous recording system comprises removable recording medium drive, a fixed disk unit connected to said removable recording medium drive, and a controller connected to said removable recording medium drive and said fixed disk unit, wherein said controller controls operation such that image data from said image compressor/decompressor is inputted to said removable recording medium drive an is recorded in removable recording medium of said removable recording medium drive; an input of said image data is changed, when said removable recording medium is replaced with a new removable recording medium, from said removable recording medium to said fixed disk unit and the image data is recorded on a fixed disk of said fixed disk unit; and the image data recorded on said fixed disk is transferred, after said removable recording medium is replaced, to said new removable recording medium, thereby continuously recording the image data.

As above, in a continuous recording method, a continuous recording system, and a surveillance system according to the present invention, there is included removable recording medium drive. Moreover, while the removable recording medium is being replaced, data is recorded on a fixed disk, and hence the continuous recording cannot be interrupted. Also, in a continuous

recording method according to claim 3 of the present invention, data is recorded in the removable recording medium at addresses thereof in a time series fashion. Therefore, in a readout operation, only by reading data therefrom in a sequential manner with respect to addresses, images can be read in a time series fashion.

To achieve the objects in accordance with the present invention, there is provided as an exemplary embodiment a digital recording method comprising the step of storing digital data in a buffer at a video capturing interval equal to or less than a video recording interval set by a user and temporarily delaying the digital data and the step of recording the digital data which is stored in the buffer and which is delayed thereby on a storage medium at the video recording interval set by a user. In accordance with the method, there is temporarily stored, in the buffer, the digital data at a video capturing interval equal to or less than the video recording interval set by the user, and part or all of the digital data recorded in the buffer is recorded on the recording medium. Since the buffer delays the digital data, there exists a margin of time to classify and to edit the data to be recorded on the recording medium.

Moreover, in accordance with the present invention, there is provided as another exemplary embodiment a digital recording method comprising the step of storing digital data in a buffer at a video

capturing interval equal to or less than a first video recording interval set by a user in a first recording mode and temporarily delaying the digital data, the step of recording the digital data which is stored in the buffer and which is delayed thereby in the first recording mode on a storage medium at the first video recording interval, the step of changing operation from the first recording mode to the second recording mode, and the step of recording the digital data stored in the buffer on the storage medium in the second recording mode, the digital data being stored before a point of time when operation is changed from the first recording mode to the second recording mode. Also the method provides the margin of time. In this method, the margin of time is used to record on the recording medium the data received before the mode change.

Additionally, in accordance with the present invention, there is provided as still another exemplary embodiment a digital recording method comprising the step of capturing digital data at a video capturing interval equal to or less than a first video recording interval set by a user in a first recording mode, conducting predetermined processing including compression for the digital data to create first compressed data, and storing the first compressed data in a buffer and temporarily delaying the first compressed data; the step of delaying by the buffer the first compressed data stored in the buffer in the first

recording mode and then recording the first compressed data on a storage medium at the first video recording interval, the step of changing operation from the first recording mode to the second recording mode, the step of creating second compressed data with an amount of data larger than that of the first compressed data and storing the second compressed data in a buffer in the second recording mode, and the step of delaying by the buffer the second compressed data stored in the buffer in the second recording mode and then recording the second compressed data on the storage medium. Also in the method, there exists the margin of time, and the second compressed data larger in the data quantity than the first compressed data is recorded on the recording medium in the second recording mode. The method is particularly effective when the mode is changed from the first recording mode to the second recording mode at or after a point of time when importance of pertinent information is increased.

In accordance with the present invention, there is provided as an exemplary embodiment a digital recording system comprising a controller for changing operation from the first recording mode to the second recording mode, a buffer connected to said controller for being controlled by said controller, for storing therein digital data at a video capturing interval equal to or less than a first video recording interval set by a user in the first recording mode, and for

temporarily delaying the digital data and a recording device connected to said controller for being controlled by said controller, for recording the digital data which is stored in said buffer and which is delayed thereby in the first recording mode on a storage medium at the first video recording interval, and for recording the digital data stored in the buffer on the storage medium in the second recording mode, the digital data being stored before a point of time when operation is changed from the first recording mode to the second recording mode. In accordance with to the system, there is temporarily stored, in the buffer, the digital data at a video capturing interval equal to or less than the first video recording interval set by the user, and part or all of the digital data recorded in the buffer is recorded on the recording medium. Since the buffer delays the digital data, there exists a margin of time to classify and to edit the data to be recorded on the recording medium. In this system, the margin of time is used to record on the recording medium the data received before the mode change.

In accordance with the present invention, there is provided as another exemplary embodiment a digital recording system comprising a controller for changing operation from the first recording mode to the second recording mode, a compressor connected to said controller for being controlled by said controller, for conducting predetermined processing including

compression for the digital data, for creating first compressed data in the first recording mode, and for creating second compressed data in the second recording mode, the second compressed data having an amount of data larger than that of the first compressed data; a buffer controlled by said controller for storing therein the first compressed data and the second compressed data at a video capturing interval equal to or less than a first video recording interval set by a user, and for temporarily delaying the digital data; and a recording device connected to said controller for being controlled by said controller and for recording the first compressed data and the second compressed data which are stored in said buffer and which are delayed thereby on a storage medium. Also in the system, there exists the margin of time, and the second compressed data larger in the data quantity than the first compressed data is recorded on the recording medium in the second recording mode. The system is particularly effective when the mode is changed from the first recording mode to the second recording mode at or after a point of time when importance of pertinent information is increased.

To achieve the object above in accordance with the present invention, there is provided a digital recording method comprising the step of setting a first recording mode and a second recording mode, the step of conducting predetermined processing including

compression for digital data, creating first compressed data in the first recording mode, and creating second compressed data in the second recording mode, the second compressed data having an amount of data smaller than that of the first compressed data; and the step of recording the first compressed data on a recording medium in the first recording mode and recording the second compressed data on a recording medium in the second recording mode.

Additionally, in accordance with the present invention, there is provided a digital recording method comprising the step of compressing digital data representing an image to create compressed data, the step of recording the compressed data on a recording medium, and the step of changing an amount of data of the digital data per unitary time during said recording step. The quantity of data can be changed by thinning out a predetermined quantity of data from the digital data (for example, when the digital data represents picture, the number of recording frames per unitary time is lowered or data per pixel is reduced).

Furthermore, in accordance with the present invention, there is provided a digital recording method comprising the step of compressing digital data to create compressed data, the step of recording the compressed data on a recording medium, and the step of changing a compression ratio to be used in the compression of the digital data during said recording

step. The recording method can be applied to a case in which three or more compression ratios are used for the compression ratio change. Favorably, said changing step includes changing the compression ratio before compression to a compression ratio after compression, the compression ratio after compression being less than the compression ratio before compression.

Moreover, in accordance with the present invention, there is provided a digital recording system comprising a controller capable of setting a first recording mode and a second recording mode, a compressor connected to said controller for being controlled by said controller, for conducting predetermined processing including compression for digital data, for creating first compressed data in the first recording mode, and for creating second compressed data in the second recording mode, the second compressed data having an amount of data smaller than that of the first compressed data; and a recording device connected to said controller for being controlled by said controller, for recording the first compressed data on a recording medium in the first recording mode, and for recording the second compressed data on a recording medium in the second recording mode.

The controller changes the mode from the first recording mode to the second recording mode according to, for example, a remaining quantity of

recordable area of the recording medium. The second compressed data may be created using the digital data thus thinned out or may be created at a compression ratio higher than that used in the first recording mode. Additionally, the recording mode may be sequentially changed as a third recording mode, a fourth recording mode, and so on.

Furthermore, in accordance with the present invention, there is provided a surveillance system comprising a surveillance camera, a video decoder connected to said surveillance camera for converting analog data outputted from said surveillance camera into digital data, an image compressor connected to said video decoder for conducting predetermined processing including compression for the digital data, a recording device connected to said image compressor for recording the compressed digital data compressed by the image compressor on a recording medium, and a controller connected to said image compressor and said recording device.

Said controller controls said image compressor to generate first compressed data in a first recording mode and second compressed data in a second recording mode, the second compressed data having an amount of data less than that of the first compressed data; and said recording device records the first compressed data on a recording medium in the first recording mode and the second compressed data on the

recording medium in the second recording mode. In the same way as for the digital recording system described above, the second compressed data may be created using the digital data thus thinned out or may be created at a compression ratio higher than that used in the first recording mode. In addition, to thin out the digital data, the surveillance system may use a capturing command, a readout command, and the like from the controller.

According to the digital recording method, the digital recording system, and the surveillance system, the second compressed data with a quantity of data less than that of the first compressed data is recorded on the recording medium in the second mode. Therefore, the period of time to record data on the recording medium is elongated by using the second recording mode when compared with the case in which only the first recording mode is used. Additionally, in the digital recording method, while the compressed data of the digital data is being recorded on the recording medium, the digital data can be thinned out or the compression ratio can be changed.

To achieve the objects above in accordance with the present invention, there is provided an image compression/decompression system comprising a detecting circuit for subdividing first image information into areas each of which has a predetermined size and for detecting a maximum value of an image change rate per

unitary distance for each of the areas, a lowpass filter for conducting predetermined filter processing for the first image information in the area having the maximum value equal to or more than a threshold value; and a JPEG codec for compressing second image information including the first image information in the area having the maximum value less than the threshold value and the first image information passed said lowpass filter, by conducting a DCT operation for the second image information.

Moreover, in accordance with the present invention, there is provided a surveillance system comprising a surveillance camera, a video decoder connected to said surveillance camera, an image compression/decompression system connected to said video decoder, a video encoder connected to said image compression/decompression system, and a display connected to said video encoder, wherein said image compression/decompression system comprises an input filter connected to said video decoder, a JPEG codec connected to said input filter, and a JPEG filter processor connected to said input filter and said JPEG codec, said input filter includes a detecting circuit for subdividing first image information into areas each of which has a predetermined size and for detecting a maximum value of an image change rate per unitary distance for each of the areas and a lowpass filter for conducting predetermined filter processing for the

first image information in the area having the maximum value equal to or more than a threshold value, said JPEG codec compresses second image information including the first image information in the area having the maximum value less than the threshold value and the first image information passed said lowpass filter, by conducting a DCT operation for the second image information, and said JPEG file processor writes, in a comment marker, file data including identifier information of the area having the maximum value equal to or more than the threshold value, differential information between the maximum value and the threshold value, and the threshold value information, and thereby creates a JPEG file together with a compressed data string outputted from said JPEG codec.

According to the image compression/decompression system and the surveillance system in accordance with the present invention, the detector circuit and the lowpass filter operate, in an area with a high image change rate, to lower the image change rate. Therefore, when a JPEG file created using the second image is decompressed, the mosquito noise can be more suppressed when compared with the case in which a JPEG file created using the first image as in the prior art is decompressed. Moreover, according to the present invention, the JPEG codec of the prior art available in the market can be directly used.

Favorably, a JPEG file processor is disposed

to write file data in a comment marker of the JPEG file. More favorably, a filter data analyzing circuit and a peaking filter are disposed to restore the filter processing conducted by the lowpass filter, and hence the original image can be replayed with higher fidelity. The detection circuit, the lowpass filter, the file data analyzing circuit, and the peaking filter can be configured as one digital signal processor.

To achieve the objects above in accordance with the present invention, there is provided an automatic setting and update method for system parameters of a surveillance system comprising the step of making a check to determine whether or not there exists a first system parameter currently being used in the surveillance system and whether or not a second system parameter to be introduced to the surveillance system is younger than the first system parameter, the step of automatically setting, when it is determined that the first system parameter does not exist in the surveillance system, the second system parameter to the surveillance system by copying the second system parameter thereonto, the step of automatically updating, when it is determined that the first system parameter exists in the surveillance system and the second system parameter is younger than the first system parameter, the first system parameter to the second system parameter; and the step of keeping the first system parameter when it is determined that the

first system parameter exists in the surveillance system and the first system parameter has a creation day equal to or younger than a creation day of the second system parameter. According to the method, the system parameters are automatically set and updated after predetermined determination.

In accordance with the present invention, there is provided an automatic setting and update method for control programs of a surveillance system comprising the step of making a check to determine whether or not there exists a first control program currently being used in the surveillance system and whether or not a second control program to be introduced to the surveillance system is younger than the first control program, the step of automatically setting, when it is determined that the first control program does not exist in the surveillance system, the second control program to the surveillance system by copying the second control program thereonto, the step of automatically updating, when it is determined that the first control program exists in the surveillance system and the second control program is younger than the first control program, the first control program to the second control program, and the step of keeping the first control program when it is determined that the first control program exists in the surveillance system and the first control program has a creation day equal to or younger than a creation day of the second control

program. According to the method, the control program is automatically set and updated after predetermined determination.

Furthermore, in accordance with the present invention, there is provided a surveillance system comprising a surveillance camera for shooting an object and for outputting an electric analog signal, a converter section for converting the electric analog signal into a digital signal, and a controller for recording and editing the digital signal, wherein said controller comprises a storage for storing therein system parameters for setting an operation environment of said surveillance system and control programs for controlling said respective sections of said surveillance system and a controlling section for controlling automatic setting and update of the system parameters and the control programs. According to the surveillance system, the controlling section controls the automatic setting and update of the system parameters and control programs.

The objects and features of the present invention will become more apparent from the description explained by referring to the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

Fig. 1 is a schematic block diagram of a surveillance system of the present invention;

Fig. 2 is a block diagram showing a main section of an image compression/decompression system in an exemplary embodiment of the present invention applicable to the surveillance system shown in Fig. 1;

Fig. 3 is a block diagram showing an exemplary configuration of an adaptive input digital filter of the image compression/decompression system shown in Fig. 2;

Fig. 4 is a block diagram showing an exemplary configuration of JPEG file processor of the image compression/decompression system shown in Fig. 2;

Fig. 5 is a block diagram showing an exemplary configuration of an adaptive output digital filter of the image compression/decompression system shown in Fig. 2;

Fig. 6 is a timing chart for exemplarily explaining a relationship between an acquiring command and image data in a recording method of the present invention;

Fig. 7 is a flowchart showing an example of a control method achieved by a CPU shown in Fig. 1;

Fig. 8 is a flowchart for explaining a recording method that can be executed by the surveillance system shown in Fig. 1;

Fig. 9 is a flowchart of an ordinary extended recording mode shown in Fig. 8;

Fig. 10 is a flowchart of a detailed recording mode shown in Fig. 8;

Fig. 11 is an exemplary timing chart for explaining effect of a recording method that can be executed by the surveillance system shown in Fig. 1;

Fig. 12 is an example of a flowchart regarding a continuous recording operation that can be executed by the surveillance system shown in Fig. 1;

Fig. 13 is another example of a flowchart regarding a continuous recording operation which can be executed by the surveillance system shown in Fig. 1;

Fig. 14 is a schematic block diagram for explaining an automatic setting and update method for system parameters and control programs in a surveillance system shown in Fig. 1;

Fig. 15 is a flowchart showing an example of an automatic setting and update method for system parameters conducted by the CPU of the surveillance system shown in Fig. 1; and

Fig. 16 is a flowchart showing an example of an automatic setting and update method for control programs conducted by the CPU of the surveillance system shown in Fig. 1.

BEST MODE FOR CARRYING OUT THE INVENTION

Referring next to accompanying drawings, description will be given of a surveillance system 100 as an exemplary embodiment of the present invention. In this connection, in respective drawings, it is assumed that the members or steps assigned with the

same reference numerals represent the same members or steps, and description will not be duplicated given thereof. Incidentally, Fig. 1 is a general block diagram of a surveillance system as an exemplary embodiment of the present invention.

As shown in Fig. 1, the surveillance system 100 includes a plurality of surveillance video cameras (surveillance cameras) 10, an alarm 12, a selector 14, a video decoder 16, an input/output filter 20, a JPEG codec 50, a frame buffer 58, a controller 60, a magnetooptical (MO) disk drive (removable disk drive) 80, a hard disk drive (fixed disk drive) 82, and a monitor 84.

I Video camera 10, alarm 12, and selector 14

The video camera 10 and the alarm 12 are arranged in a department store, a convenience store, a bank, a museum, and the like, and in the configuration, the alarm 12 is connected to a sensor (not shown) such as an infrared ray sensor, a voice sensor, or the like disposed on a door or the like such that when the sensor senses a suspicious person, a switch of the alarm 12 is turned on. The surveillance camera 10 can be materialized, for example, as a charge coupled device (CCD) camera to converter an image of object shot by the camera into an analog electric signal. In the embodiment, only one alarm 12 is disposed commonly for a plurality of sensors, however, the alarms may be

selectively disposed or one alarm may be disposed for each sensor.

Information from the video cameras 10 and alarm 12 is sent via communication lines to a guardroom in the premises where the video cameras 10 and alarm 12 are installed or to a security guaranteeing company at a remote place. In the guardroom or the security guaranteeing company, there are disposed the selector 14, the video decoder 16, the video encoder 18, the input/output filter 20, the JPEG codec 50, the controller 60, the magnetooptical disk drive 80, and the hard disk drive 82. These components may be considered as one digital video recording device. However, when the controller 60 is configured as a general personal computer and the magnetooptical disk drive 80 and the hard disk drive 82 are configured as a magnetooptical disk drive and a hard disk drive which respectively are integrally constructed in the personal computer, the system can be configured as one personal computer. Naturally, the controller 60 may integrally includes either one thereof.

The selector 14 can extract, from the analog signals generated by the shooting operation of the surveillance cameras 10, only a signal component of one of the cameras 10 and only a signal component necessary for the recording operation from the signal component of the camera.

II Input/output filter 20

The input/output filter 20 removes noise of a propagation path and includes an input filter 30 and an output filter 40. Although the input/output filter 20 is favorably configured as an adaptive input/output digital filter, either one or both of the input and output filters may be configured as a general filter in the present invention. However, in the description below, the input filter 30 is configured as an adaptive input digital filter to receive input image information to be compressed and the output filter 40 is configured as an adaptive output digital filter to produce output image information.

II-1 Image compression/decompression system

Next, connection between the input/output filter 20 and the JPEG codec 50 will be described in detail by referring to Fig. 2. In this regard, Fig. 2 is a block diagram showing a main section of an image compression/decompression system 110 as an exemplary embodiment of the present invention. As shown in Fig. 2, the image compression/decompression system 110 includes an input filter 30, a JPEG codec 50, a JPEG file processor 120, and an output filter 40. Additionally, the JPEG file processor 120 is connected to an external storage 130. The JPEG codec 50 is connected to a frame buffer 58. Incidentally, in implementation of an actual circuit, the adaptive input

digital filter 30 and the adaptive output digital filter 40 can be integrally configured, for example, in one digital signal processor (DSP) customized for filter calculation. The JPEG file processor can be implemented by use of a control program stored in a second memory 74 such as a read-only memory (ROM) of or a hard disk 83 of the controller 60. Moreover, although the external storage 130 is a magnetooptical disk drive 80 in Fig. 1, the storage 130 is not restricted by this embodiment but includes any other external storage (such as a DVD drive, a CD-RW drive, or the like).

II-2 Adaptive input digital filter 30

As shown in Fig. 3, the adaptive input digital filter 30 includes a differential coefficient detecting circuit 32, a subtractor 34, a lowpass filter 36, and a switching circuit 38. In this regard, Fig. 3 is a schematic block diagram showing an exemplary configuration of the adaptive input digital filter 30. The filter 30 generates filter data and image data and outputs the filter data to the JPEG file processor 120 and the image data to the JPEG codec 50. The file data is finally written in a comment marker of the JPEG file, which will be described later. The image data is finally generated as a compressed data string of the JPEG file.

The adaptive input digital filter 30 has a

function in which for each area of 8 pixels by 8 pixels (to be referred to as "block"), a section thereof in which input image information abruptly changes is determined to pass only the section through the lowpass filter 36. In this embodiment, whether or not image information abruptly changes is determined by a differential coefficient representing a rate of change of an image per unitary distance.

The differential coefficient detector 32 detects a differential coefficient of input image information. The detector circuit 32 selects as a reference point a point near a center of a block and obtains "maximum value - minimum value" for each of data items of 8 vertical points by 8 longitudinal points including the reference point. The image is ordinarily converted into a digital image format called "YCrCb". In this regard, Y represents a luminance component of the image and Cr and Cb represent color components. Since a color is expressed in two dimensions, Cr and Cb represent two axes of orthogonal coordinates. Therefore, one image includes three components of Y, Cr, and Cb.

The differential coefficient is in principle checked for each of the three components. However, the eyes of a human are actually most sensitive to luminance and hence the differential coefficient check may be conducted only for the luminance component. Of two values obtained as a result, a larger one is

regarded as a maximum differential coefficient. In this connection, there may exist data which cannot be detected by this method and which has a large differential coefficient. However, an area of such data has a maximum size of 4 pixels by 4 pixels and the data is independent in this size, hence it is assumed in this embodiment that even if the data is ignored, there rarely appears influence. The differential coefficient detector 32 information of Di to the subtractor 34 and information of Bi to (a control section thereof, not shown) of the switching circuit 38, which will be described later.

The subtractor 34 includes two inputs and one output. One of the inputs is supplied with an output from the differential coefficient detector 32, i.e., a differential coefficient Di (i is a block number) of an objective block of the input image information. The other one of the inputs is supplied with a preset threshold value Ds. For the subtractor 34, any such a circuit well known in the pertinent technical field can be used. The subtractor 34 produces an output which is fed as filter data to the JPEG file processor 120 and to the lowpass filter 36.

The lowpass filter 36 can receive input image information, however, operation thereof is controlled by the output from the subtractor 34. In other words, to set the maximum value of the differential coefficient Di of the image information to Ds, the

lowpass filter 36 changes a filter coefficient according to the output (Di - Ds) from the subtractor 34. Therefore, when Di - Ds is a large value, the lowpass filter 36 increases the filter coefficient, and when Di - Ds is a small value, the lowpass filter 36 decreases the filter coefficient.

The switching circuit 3 includes a control section, not shown. The control section conducts a switching control operation by receiving information from the differential coefficient detector 32. That is, for a block Bi (i is a block number) having a differential coefficient Di larger than the threshold value Ds, the control section allows the block to pass through the lowpass filter 36. For any block Bj ($j \neq i$; j is a block number) not equivalent to the block Bi, the control section does not allow the block to pass through the lowpass filter 36.

Consequently, when the threshold value Ds is set to a sufficiently large value, no block Bi passes the lowpass filter 36 in the image compression/decompression system 110. This leads to an advantage substantially equal to the advantage of the configuration in which the adaptive input digital filter 30 is not disposed as in the prior art. On the other hand, as the threshold value Ds becomes smaller, occurrence of the mosquito noise can be more efficiently suppressed. However, this increases the loss of high-frequency components and hence in a

replayed image, a sharp contour cannot be obtained, namely, the contour becomes obscure. In consideration of this point, the image compression/decompression system 110 of the embodiment determines an optimal value of Ds by simulation for each objective image.

II-3 JPEG codec 50 and frame buffer 58

The JPEG codec 50 sends image data as a JPEG file via a PCI bus 62 to a magnetooptical disk drive 80 and/or the hard disk drive 82, which will be described later. However, it is assumed in the description below that the JPEG codec 50 transmits the JPEG file to the magnetooptical disk drive 80. When the JPEG codec 50 supplies output data to the hard disk drive 82, it is only necessary to replace the magnetooptical disk drive 80 with the hard disk drive 82 in the description. The recording method as an exemplary embodiment of the present invention will be described as part of operation of the surveillance system.

The JPEG codec 50 uses a JPEG compression/decompression algorithm to conduct a sequential discrete cosine transformer (DCT) operation and a Hoffman coding/decoding operation. The JPEG compression/decompression algorithm is well known in the pertinent technical field as an algorithm which is based on ISO/IEC10918-1 (JPEG standard) and which converts (compresses) still picture data into a smaller amount of data and which restores (defrosts or

decompresses) the data into the original image data. The JPEG compression/decompression algorithm uses a compression/decompression ratio set by a control program stored in a second memory 74, which will be described later, or a compression/decompression specified by the user. The JPEG codec 20 can be configured using, for example, MD2310 of Fuji Film Microdevice. As above, according to the present invention, an LSI chip for any JPEG codec generally used in the pertinent technical field at present can be directly used without changing specifications thereof. Additionally, the JPEG codec 50 has a function to control the frame buffer 58.

Some JPEG codecs available in the market can recognize a comment marker. However, the JPEG file processor 120 of the image compression/decompression system 110 of the present invention extracts comment marker information and sends a JPEG file not containing information described in the comment marker to the JPEG codec 50, which will be described later. Therefore, in short, regardless of the function to recognize the comment marker, a JPEG coded available in the market can be used as the JPEG codec 50 of the image compression/decompression system 110 of the present invention. As above, it is not necessary to modify or to fabricate the LSI chip for the JPEG codec, the cost of the system 110 is not increased.

Typically, the JPEG codec 50 includes a DCT

section 52 and a Hoffman coder/encoder 54 as shown in Fig. 2 and can compress input image information and can decompress compressed data. The DCT section 52 receives image data from the adaptive input digital filter 30 and conducts a DCT operation for each block thereof. The Hoffman coder/encoder 54 represents data resultant from the DCT operation using a possibly small number of bits. This results in creation of compressed data. The compressed data produced at this point does not contain information indicating how the filtering is conducted for each block by the lowpass filter 36. The compressed data string is transmitted to the JPEG file processor 120.

On the other hand, in the data decompression, the JPEG codec 50 receives from the JPEG file processor 120 a JPEG file from which information of a comment marker has been extracted and removed, decompresses the JPEG file, and outputs a result of the decompression to the adaptive output digital filter 40, which will be described later.

When the monitor 84 is subdivided into a plurality of screens to display picture therein, the frame buffer 58 may be replaced with a strip buffer (a memory to store eight lines of image data). Although the frame buffer 58 has several other functions, the frame buffer 58 in relation to the recording method of the present invention is a unit in which digital image data is temporarily stored and from which the data is

read by the JPEG codec 50 thereafter.

II-4 JPEG file processor 120 and external storage 130

The JPEG file processor 120 includes a marker analyzing section 122 as shown in Fig. 4. The marker analyzer 122 has a function to receive, in image information compression, filter data from the adaptive input digital filter 30 and a compressed data string from the JPEG codec 50 so as to create a JPEG file. In this regard, Fig. 4 is a general block diagram showing an exemplary configuration of the JPEG file processor 120. The marker analyzer 122 can communicate with the external storage 130 and can communicate a JPEG file via a communication facility such as a communication line with another system at a remote location. Moreover, in JPEG file decompression, the marker analyzer 122 analyzes a comment marker of the received JPEG file, extracts information thereof to create file data, sends the JPEG file from which the comment marker information has been removed to the JPEG codec 50, and transmits the file data to the adaptive output digital filter 40.

The JPEG file includes a compressed data string undergone the Hoffman coding and a marker in which an attribute of the compressed data string and information necessary for decompression thereof are described. The is one of various kinds of markers such as an SOI marker, an EOI marker, and RSTm marker, a

frame header (SOF0, SOF1) marker, a scan header (SOS) marker, a quantization table definition (DQT) marker, a Hoffman table definition (DHT) marker, a restart interval definition (DRI) marker, a comment (COM) marker, an application (APPn) marker, and an image line number definition (DNL) marker. Each marker is assigned with information unique thereto stipulated by ISO/IEC10918-1.

Of the markers, the comment marker is accessed by the JPEG file processor 120 to write therein information indicating how the filtering is conducted for which one of the blocks by the lowpass filter 36. Furthermore, of the markers, the quantization table definition (DQT) marker is used to described therein a compression ratio. Therefore, when a magnetooptical disk 81 on which such a JPEG file is recorded is used in a magnetooptical disk drive of another system, the JPEG codec of the system can recognize the decompression ratio using the quantization table definition (DQT) marker.

In the comment marker, identifier information of the comment marker is written in two leading bytes and information of the number of bytes thereof is written in two succeeding bytes. According to the ISO/IEC10918-1, the comment marker can be freely set by the user. Ordinarily, a name of product, a name of company, and other comment are written in the comment marker.

In this embodiment, the filter data format added to the comment marker is as follows. Therefore, when a name of product is beforehand written therein, the format is added thereto following the name of product. In this regard, the data is written in the byte unit, and each data ranges from 0 to 255.

First, data of the threshold value Ds is written. Thereafter, for each block which passes the lowpass filter 36, one set of three-byte data is repeatedly written as follows.

Block address x-coordinate value	1 byte
Block address y-coordinate value	1 byte
Differential data for maximum change rate	1 byte

For example, for an image having a size of 640 pixels x 480 pixels, blocks are arranged in a matrix including 640/8 = 80 horizontal blocks x 480/8 = 60 vertical blocks. To 80 x 60 = 4800 blocks, block addresses are assigned. In the image, the upper-left corner is assumed as an origin, and the x coordinate value increases toward the right direction and the y coordinate value increases toward the downward direction. For example, (0,0) is a block address indicating a block at the upper-left corner and (10,12) is a block address indicating a block at a position represented by a combination of the 11th block from the left end and 13th block from the upper end.

As above, the filter data format is configured with the first byte is Ds and 3-byte data items succeeding Ds. The JPEG file processor 120 of the present invention identifies data, for example, that the data in the comment marker is filter data or simply a comment, by adding two data items as follows. One of the data items is stored in a 2-byte area following Ds to declare the number of data items succeeding the 2-byte area. The other one thereof is a 1-byte check sum disposed after the last data item. The check sum area contains a value obtained as follows. The respective bytes of the data items of the filter data are added to each other, the resultant value is then subtracted from zero, and then eight low-order bits of the result of the subtraction is used as the check sum. Since two bytes after Ds declares the number of data items, the number of bytes of the filter data can be recognized.

Therefore, if the filter data is configured in the filter data format, when the respective data items from the first data item to the last item of the file data are added to each other, the result must be zero. Otherwise, it is assumed as incorrect file data or it is assumed simply as a comment. When a comment is to be disposed in addition to file data, a sequence thereof is beforehand determined such that a comment is placed after the filter data. According to the data layout, the JPEG file processor 120 makes a check

assuming that file data exists as first data in the comment marker, and if the addition of data items of the respective bytes results in zero, the processor 120 recognizes that the data is filter data. Additionally, if any other data exists thereafter, the processor 120 recognizes the data as a comment. Moreover, if the result of the addition is other than zero, the processor 120 assumes that the data includes simply comment data and does not include any filter data.

When the JPEG file processor 120 writes the necessary information in the comment marker as above, there is completely formed a JPEG file containing a marker including the comment marker and a compressed data string representing image data. Since JPEG file processor 120 of the present invention does not change the compressed data string, compatibility can be retained for the JPEG file which can be treated by a JPEG codec (and a JPEG decompressor) of the prior art.

The JPEG file processor 120 can store the completed JPEG file in the external storage 130 (including a removal memory, e.g., a magnetooptical disk). Or, when the JPEG file processor 120 is configured as the controller, the JPEG file processor 120 can store the completed JPEG file in the hard disk drive 82 of the controller 60. Additionally, the JPEG file processor 120 can also transfer the JPEG file via a communication device such as a modem, not shown, to another computer. The JPEG file is compressed by the

JPEG codec 50 and hence can be transferred at a speed higher than a transfer speed at which original image information is directly transferred.

II-5 Adaptive output digital filter 40

The adaptive output digital filter 40 includes a filter data analyzing circuit 42, an adder 44, a peaking filter 46, and a switching circuit 48 as shown in Fig. 5. In this connection, Fig. 5 is a general block diagram showing an exemplary configuration of the adaptive output digital filter 40. The filter 40 receives filter data from the JPEG file processor 120 and image data including data obtained by decompressing the compressed data string from the JPEG codec 50 and then resultantly outputs image information. The image information is used thereafter to replay an image. The digital filter 40 has a function which allows a block having passed the lowpass filter 36 to pass the peaking filter 46 to conduct a filter operation according to the filter data. Moreover, the digital filter 40 has a function to directly output therefrom a block not having passed the lowpass filter 36.

The image compression/decompression system 110 as an exemplary embodiment of the present invention favorably includes the adaptive output digital filter 40. However, even when the system 110 does not include the output filter 40, the system brings about an

advantage to minimize the mosquito noise more efficiently when compared with the circuit configuration including only the JPEG codec of the prior art for the following reason. That is, the lowpass filter 36 has already minimized the mosquito noise, and the peaking filter 46 is disposed to restore an obscured contour of the image caused by the lowpass filter 36. However, the obscured contour of the image is less effective for a sense of incongruity as compared with the mosquito noise. Therefore, also the image compression/decompression system 110 not including the output filter 40 sufficiently has an advantage of the present invention. It is to be understood that such an advantage becomes an issue, for example, in a case in which a JPEG file created by the image compression/decompression system 110 of the present invention is transferred to a system of the prior art including only a JPEG codec and is replayed by the system of the prior art.

The filter data analyzer 42 recognizes a block having passed the lowpass filter 36, a threshold value, Ds, and difference between a differential coefficient Di of the block Bi and the threshold value Ds. The analyzer 42 sends information of Bi to the switching circuit 48 and information of the difference to the adder 44.

The adder 44 adds Ds to the difference received from the analyzer 42 to replay Di and then

transmits resultant information to the peaking filter 46. The threshold value Ds used by the adder 44 is not necessarily equal to Ds stored in the input filter 30 depending on cases, which will be described later.

The peaking filter 46 receives expanded image data from the JPEG codec 50, and operation of the filter 46 is controlled by the output from the adder 44. In other words, to replay an original image through a filter operation reverse to that of the lowpass filter 36, the peaking filter 46 changes its filter coefficient according to the output Di from the adder 44. Therefore, when Di takes a large value, the peaking filter 46 makes the filter coefficient smaller, and when Di takes a small value, the peaking filter 46 makes the filter coefficient greater. As above, the peaking filter removes the problem of the obscured contour of the image caused by the lowpass filter 36, and hence it is possible to replay an image with higher fidelity to the original image.

The switching circuit 48 includes a control section, not shown. The control section receives a result from the filter data analyzer 42 to conduct a switching control operation in which a block Bi (i is a block number) having a differential coefficient Di larger than the threshold value Ds is allowed to pass the peaking filter 46 and a block Hj ($j \neq i$; j is a block number) not equivalent to Bi is not allowed to pass the peaking filter 46.

II-6 Image compression/decompression system 110

Operation of the image compression/decompression system 110 will be described later in conjunction with the surveillance system 100 of the present invention which is described by referring to Fig. 1. In Fig. 1, the age compression/decompression system 110 is materialized as part of the monitory system 100. In consideration of minimization of the cost and the number of parts, the adaptive input digital filter 30 and the adaptive output digital filter 40 are collectively configured as one DSP 20, and the JPEG file processor 120 is configured using a control program stored in the second memory 74 of the controller 60. The control program also controls other respective components connected to the controller 60.

III Controller 60

The controller 60 includes a PCI bus 62 as an extended substrate, a first interface 64, a second interface 68, a CPU 70, a first memory 72, a second memory 74, a switching circuit 75, a communication unit 76, and a clock 78. In this connection, in an actual circuit, a bridge circuit is inserted as an interface between the CPU 70 and the PCI bus 62.

The PCI bus 62 is connected to the first, second, and third interfaces 64, 66, and 68, the JPEG

codec 50, the first memory 72, the second memory 74, the switching circuit 75, and the communication unit 76. Incidentally, in addition to or in place of the PCI bus 62, there may be dispose another bus such as an USB bus or an industry standard architecture (ISA). The first interface 64 communicates with the alarm 12. The second interface 66 communicates with the magnetooptical disk drive 80 and may include, for example, a small computer systems interface (SCSI). The third interface 68 communicates with the hard disk drive 82 and may include, for example, an integrated drive electronics (IDE) interface. Any configurations well known in the pertinent technical field can be applied to the interfaces 64, 66, and 68, and detailed description thereof will be avoided in this paragraph. Incidentally, the magnetooptical disk drive 80 may be replaced with any types of removable recording medium drive (e.g., a compact disk (CD) - RW drive and a super disk drive).

The CPU 70, the first and second memories 72 and 74, and the clock 78 are used to execute a recording method as an exemplary embodiment of the present invention, which will be described later. The first and second memories 72 and 74 may be considered as one main memory.

The first memory 72 includes, for example, a volatile memory such as a dynamic random access memory (DRAM) or a static RAM (SRAM). Loaded in the first

memory 72 is a control program stored on the hard disk 83 and/or the second memory 74. Moreover, in the first memory 72, a compressed data string sent from the JPEG codec 50 and/or a JPEG file converted by the CPU 70 can be temporarily stored.

The second memory 74 stores therein control programs (application programs) to control respective sections and includes, for example, flash ROM having stored necessary basic input output system (BIOS) data. Alternatively, the second memory 74 may be part of the hard disk 83 of the hard disk drive 82. More concretely, the control programs include a hard logic control part to control the JPEG codec 50 and the like, a user interface part, a disk access part, and the like. The application programs to implement the recording method as an exemplary embodiment of the present invention can be created using any known developing tools such as Visual C++ and Borland C++, and hence detailed description thereof will be avoided in this paragraph.

The CPU 70 controls the respective sections according to system parameters and control programs, which will be described later. Furthermore, the CPU 70 is simply an example of a controller including a micro-processing unit (MPU) and the like.

The switching circuit 75 determines that the compressed data string from the JPEG codec 50 is supplied to the magnetooptical disk drive 80 or the

hard disk drive 82.

The clock 78 can detect and display a point of time and/or a period of time and is used by the CPU 70 to conduct control operations, which will be described later. Fig. 1 shows the clock 78 as a clock integrated in the controller (for example, an internal electronic clock in a general personal computer). However, the clock 78 may be an external clock for the controller 60.

The second and third interfaces 66 and 68, the CPU 70, the first and second memories 72 and 74, the switching circuit 75, the magnetooptical disk drive 80, and the hard disk drive 82 constitute a continuous recording system as an exemplary embodiment of the present invention. The continuous recording system is less expensive than the system of the prior art because only one magnetooptical disk drive is required, the prior-art system requiring two magnetooptical disk drives. Additionally, since the continuous recording system can be configured using one personal computer as described above, the system space can be minimized. Operation of the continuous recording system will be described as part of the operation of the surveillance system 100.

The hard disk 83 of the hard disk drive 82 stores thereon, for example, system parameters of the surveillance system 100. The system parameters are operation environments such as an image compression

ratio used by the JPEG codec 50, a recording time set when an alarm signal is received from the alarm 12, a switching sequence and a switching interval of the monitor cameras 10 by the selector 14, a recording interval of frame, and an image capturing interval. When it is necessary to change the operation environments, the user may individually change the system parameters.

The communication unit 76 is constituted, for example, with a modem and is connected to a communication line such as a commercial online system (e.g., American Online) and/or a leased line. Since the communication line is also connected to a maker of the recording method of the present invention, which will be similarly later described, the user can receive an update service of the recording method as an exemplary embodiment of the present invention, for example, via an internet provider.

Next, operation of the surveillance system will be described. When a power supply, not shown, of the controller 60 of the surveillance system 100 is turned on, an operating system (OS) automatically executes an application program stored in the second memory 74 to load necessary programs in the first memory 72.

First, when a suspicious person enters a monitor objective zone, the sensor senses the suspicious person and an alarm signal is sent to the

interface 64 connected to the PCI bus 62 of the controller 60. In response thereto, the controller 60 controls the selector 14 to select the video camera 10 near the suspicious person such that the camera tries to identify the suspicious person. Selectively, the selector 14 may supply information of a place of the suspicious person to the video camera 10 to change and/or to adjust a direction and a focusing condition of a lens of the video camera 10. The image shot by the video camera is represented, for example, by a plurality of consecutive frames successive in a time series fashion, each frame having a rectangular contour of 240 vertical pixels by 720 horizontal pixels.

In this embodiment, while the video cameras 10 are continuously powered, an operation to record images thereof is started by an alarm signal. Naturally, regardless of the alarm signal, the event image recording may be continuously conducted or may be started when a timer (not shown) indicates arrival of a predetermined time (for example, 6 p.m. at which the working hours end). Moreover, alternatively, the recording may be started in response to a manual operation to depress a record button. In either case, it is necessary to replace the magnetooptical disk 81 of the magnetooptical disk drive 80. It is to be understood that the period of time in which the continuous recording is possible is further reduced when a super disk drive is employed in place of the

magnetooptical disk drive 80, that is, when a recording medium such as a super disk having a storage capacity smaller than that of a magnetooptical disk 81 is used in place thereof.

Information from the video camera 10 is inputted to the video decoder 16 with a correspondence established between the information and the pertinent camera by the selector 14. For convenience of explanation, attention will be directed only to information from one video camera 10 in the following description. An analog composite signal sent from the video camera 10 is converted by the video decoder 16 into a digital image and is sent to the adaptive input digital filter 30 of the DSP 20. In this situation, the user beforehand operates the DSP 20 or the controller 60 to store a desired threshold value Ds in the adaptive input digital filter 30.

The adaptive input filter 30 checks by the differential coefficient detector 32 a differential coefficient of the input digital image to determine whether or not the input digital image is allowed to pass the lowpass filter 36. The input filter 30 then transmits information of filter data including Bi, Ds, and Di - Ds via the PCI bus 62 to the CPU 70 of the controller 60. The switching circuit 38 sends image data to the JPEG codec 50. Specifically, the switching circuit 38 sends Bi via the lowpass filter 36 to the JPEG codec 50 and sends Bj directly thereto. However,

the JPEG codec 50 can receive the image data only after the JPEG codec 50 has received a capturing command issued by the CPU 70 using the control program.

The surveillance system as an exemplary embodiment of the present invention can use several recording methods respectively in an independent way or can use combinations thereof. The recording methods include an extended recording method in which the recording time is extended by deleting data items duplicated in the data to be recorded and a continuous recording method to prevent data loss during the replacement. Moreover, according to the present invention, there is also proposed a detailed recording method in which even when the extended recording method is adopted, the data recording density is increased beginning at a point of time which is a predetermined period of time before occurrence of an alarm signal.

IV Extended recording method

Next, description will be given of an extended recording method as an exemplary embodiment of the present invention. The recording method aims at elongating the recording period of time of the magnetooptical disk 81 (without changing the storage capacity thereof). Therefore, the controller 60 as an exemplary embodiment of the present invention can set at least two kinds of recording mode, namely, an ordinary recording mode and an extended recording mode.

Specifically, "ordinary recording mode" is a mode in which data is recorded with a maximum density with which the surveillance system 10 can record data (determined by the video capturing interval or the number of frames). "Extended recording mode" is a mode in which data is recorded with a density lower than that used in the ordinary recording mode. The present invention is particularly suitable for a situation in which, for example, when the replacement of the magnetooptical disk 81 is delayed, at least part of (favorably, all of) information of the images shot during the delayed period of time is to be recorded.

That is, the surveillance system 100 can be used not only for the continuous recording of the objects but also for an intermittent recording operation depending on cases. Moreover, the consecutive recording time of the monitor camera digital recording/replay unit is generally shorter than that of an analog time lapse video tape recorder. Consequently, to extend the recording time of the overall system, it is required to efficiently record images of objects. For this purpose, information of duplicated object images less important in the system is removed in the recording operation.

Subsequently, description will be given of a first embodiment of the recording method according to the present invention. In the recording method of the present invention, the number of frames of image data

recorded per unitary time on the magnetooptical disk 81 is reduced to minimize the quantity of data recorded on the disk 81 to thereby extend the recording period of time of the disk 81. This method is implemented using the following fact. That is, in the recording method of the present invention, since continuous image data contains substantially the same information in its sections within quite a short period of time, omission or (thinning out) of data does not considerably influence quality of resultant information. Therefore, although image data in a short period time is lost, the overall recording time is extended.

It is possible to set the control program such that whether or not the recording method of the embodiment is adopted is specified as a user option. In this situation, by determining a desired recording method according to importance of the image data, the user can use the recording method of the embodiment beginning at the recording start point or at a point of time, for example, 30 minutes before the replacement of the magnetooptical disk 81.

There exists a case in which, for example, image data contains quite short information regarding a face of a suspect possibly shot by the camera 10. In such a case, it is not desirably to thin out the image data beginning at the record starting point. On the other hand, it is also not favorable that all image data cannot be obtained when the user forgets

appropriate replacement of the magnetooptical disk 81. Therefore, in this situation, the ordinary recording mode is used in the record starting phase to continuously record image data to guarantee recording of all image data, and the extended recording mode can be used beginning at a point of time 30 minutes before the replacement of the magnetooptical disk 81.

In this regard, the recording method of the embodiment can be executed in a plurality of methods including four methods as below. However, the present invention is not restricted by these methods, namely, it is to be appreciated that any method which guarantees the advantage to reduce the number of record frames per unitary time and the advantage of reducing the record data quantity per unitary time can be used. Additionally, which one of the methods is to be used can be beforehand set by the user or by the CPU 70 using default values. It is also possible to use a combination of these methods.

IV-1 Recording under control of capturing command

In a first method, occurrence of a capturing command is controlled to reduce the number of frames per unitary time. This method will be next described by referring to Fig. 6. In this connection, Fig. 6 is a timing chart for exemplarily explaining a relationship between an acquiring command and image data in a recording method of the present invention.

In Fig. 6, a capturing command TC is indicated by an on state and an off state. In the on state, the capturing command is being issued, and in the off state, the capturing command is not being issued. As above, the JPEG codec 50 can capture image data (ID; digital data) from the input filter 30 only when the capturing command is being issued.

As shown in an upper section of Fig. 6, when the CPU 70 sends a capturing command TC to the JPEG codec 50 at time 0, the JPEG codec 50 continuously (i.e., not intermittently in a time series fashion) captures image data ID beginning at time 0. The captured image data is entirely and continuously recorded on the magnetooptical disk 81, which will be described later. For example, when an image including frames of which each includes Pn bytes is recorded, by a capturing command shown in the upper section of Fig. 6, at a rate of n frames per second on the magnetooptical disk 81 having a storage capacity of Cr bytes, a period of time T1 (seconds) available for the continuous recording is represented by expression (1).

$$T1 = Cr/Pn \cdot n$$

This means that when the recording is started at time 0, the magnetooptical disk 81 can record the image data until time T1. In other words, if the disk 81 is not replaced, no image data is recorded after the

point of time T1.

On the other hand, a shown in a lower section of Fig. 6, when the capturing command TC is repeatedly turned on and off, the JPEG codec 50 captures only image data items I1, I3, and so on, and image data items I2, I4, and the like are thinned out. In the first method, the data is thinned out in the frame unit. The CPU 70 can freely set the capturing command on/off period such as t1, t2 - t1, t3 - t2, or t4 - t3. When the capturing command TC is on, the associated image data items I1, I3, etc. are recorded on the magnetooptical disk 81 in a continuous way (that is, after image data I1, the image data I3 is immediately recorded thereon), which will be described later.

Assume that according to the capturing command shown in the lower section of Fig. 6, the image data ID is recorded on the magnetooptical disk 81 having a storage capacity of Cr bytes. Until a remaining storage capacity of the disk 81 becomes Ca bytes, the image data is recorded at a rate of n frames per second, each frame including Pn bytes. After the remaining storage capacity of the disk 81 becomes Ca bytes, the image data ID is recorded at a reduced rate of m frames per second. In this situation, when the magnetooptical disk 81 is not replaced, the magnetooptical disk 81 can continuously record image data ID for a period of time of T2 by expression (2).

$$T2 = (Cr - Ca)/ Pn \cdot n + Ca/Pn \cdot m$$

This means that when the recording is started at time 0, the magnetooptical disk 81 can record the image data until the point of time T2. Additionally, T2 - T1 is represented by expression (3).

$$T2 - T1 = Ca(n - m)/Pn \cdot n \cdot m > 0$$

Therefore, according to the recording method of the embodiment, the magnetooptical disk 81 can record image data in a time zone of T2 - T1 in which no image data can be recorded in the prior art. In this connection, since the storage capacity Cr of the disk 81 is kept unchanged, the period of time T2 - T1 also equivalent to the total thin-out time of image data.

Moreover, since the controller 60 of the present invention can change the capture command on/of period as above, the recording time may be extended by recording an image including frames of which each includes Pn bytes, for example, at a stepwise reducing recording density: n frames per second, m frames per second, 1 frame per second, and k frame per second (n > m > 1 > k).

IV-2 Recording under data capturing control of video decoder 16 and/or input filter 30

Next, description will be given of a second

method used in the first embodiment of the present invention. In the second method, image data is thinned out when the input filter 30 captures image data from the video decoder 16 and/or the JPEG codec 50 captures image data from the input filter 30. Assume that the JPEG codec 50 captures image data from the input filter 30 by the capturing command shown in the upper section of Fig. 6, the image data including, for example, frames each of which is represented as 240 vertical pixels by 720 horizontal pixels (the image data corresponds to 345,600 bytes when two bytes are required as data per pixel). In this situation, when every second pixel is thinned out in the vertical and horizontal directions, there will be recorded image data (corresponding to 86,400 bytes) representing a rectangular image of 120 vertical pixels by 360 horizontal pixels (the size thereof is half that of the original image). It can be understood that the number of necessary bytes to be recorded is thus reduced and hence the recording time on the magnetooptical disk 81 is elongated. In the second method, the data is thinned out in the pixel unit as above.

The JPEG codec 50 used in the present invention has a function to thin out a desired amount of data from the image data from the input filter 30 according to a command from the CPU 70. The CPU 70 of the controller 60 can set the amount of thin-out data using a control program. The present invention has an

advantage that the configuration is simplified since it is not necessary to install an independent thin-out device. However, according to the present invention, there may be installed an independent thin-out device. When an independent thin-out device is installed, the configuration is particularly efficient in a case in which an image compression/depression device other than the JPEG codec is used and the image compression/depression device has not an image data thin-out function.

IV-3 Recording under control of frame buffer 58

Description will be next given of a third method used in the first embodiment of the present invention. In this method, the JPEG codec 50 selects image data read from the frame buffer 58. First, according to a capturing command shown in an upper section of Fig. 2, the JPEG codec 50 captures image data sent from the input file 30 and then immediately and temporarily stores the image data in the frame buffer 58 without conducting an operation of the JPEG compression/decompression algorithm. Thereafter, the JPEG codec 50 reads the image data from the frame buffer 58 according to a readout command from the CPU 70. When the readout command from the CPU 70 is set to a form similar to that of the capturing command shown in a lower section of Fig. 2, there can be obtained an advantage similar to that of the capturing command

shown in the lower section of Fig. 2. Therefore, the data is thinned out in the frame unit in the third method. That the CPU 70 can control the readout command according to a control command is substantially the same as for the first method.

IV-4 Recording under data capturing control of frame buffer 58

Next, description will be given of a fourth method used in the first embodiment of present invention. In this method, the JPEG codec 50 thins out image data read from the frame buffer 58 in the same manner as for the second method. It is therefore to be understood that the fourth method has an advantage similar to that of the second method. Consequently, the data is thinned out in the pixel unit in the fourth method. That the CPU 70 can control the thin-out data amount according to a control command is substantially the same as for the second method.

IV-5 Recording by controlling compression ratio

The JPEG codec 50 receives the image data, conducts a DCT operation and a Hoffman coding for the image data to obtain a compressed data string, and transmits the compressed data string via the PCI bus 62 to the CPU 70 of the controller 60. The general operation of the JPEG codec 50 is well known in consideration of, for example, the MD2310 described

above, detailed description thereof will be avoided in this paragraph. In a typical recording method of this embodiment, the compression ratio used in the JPEG compression/decompression algorithm is set to a value higher than that of a compression ratio ordinarily used in the prior art (i.e., the compression ratio of the ordinary recording mode) to reduce the amount of data recorded on the magnetooptical disk 81 to thereby elongate the recording time of the disk 81. For example, a compression ratio of 1/20 in the prior art is changed to a compression ratio of 1/25. The CPU 70 can freely set the compression ratio according to the system parameters stored on the hard disk 83 as described above. Whether or not the recording method of the embodiment is adopted or whether or not the method of this embodiment is combined with the recording method of the first embodiment can be specified as a user option.

In the recording method of this embodiment, although there occurs no data loss by the image data thin-out operation, but data loss takes place by increasing the compression ratio. In the sequential DCT operation, a point of image data and another point quite near the point are assumed to be equal or similar in data to each other. By achieving a Fourier transform for a scalar quantity representing a point of an image to convert the scalar quantity into a power spectrum along a frequency axis, any power spectrum at

a frequency equal to or more than a particular frequency can be regarded as zero. By regarding the spectrum as zero, particular data is removed, which corresponds to "compression". Therefore, when a data string compressed by the sequential DCT operation is expanded, the original image is not completely replayed, that is, the decompressed data includes a loss. When the compression ratio is increased, the loss is also increased in general.

IV-6 Control by CPU 70

The CPU 70 writes information of file data in a comment marker to create a JPEG file together with a compressed data string and then temporarily stores the JPEG file in the first memory 72. Thereafter, the CPU 70 transfers the JPEG file from the first memory 72 to the magnetooptical disk drive 80 to record the JPEG file on the magnetooptical disk 81. Selectively, the controller 60 can transmit the JPEG file via a modem and a communication line, not shown, connected to the PCI bus 62 to another system. These operations are controlled by the control program. Simultaneously, the CPU 70 can obtain, using an application program loaded in the first memory 72, information of a recording start time and a current time from the clock 78 to know a remaining period of time to store data on the magnetooptical disk 81 (and/or a remaining available capacity thereof).

Next, an example of the control method used by the CPU 70 will be described by referring to Fig. 7. Before the operation is started, the CPU 70 can sends a request to the user to determine whether or not the user requires a change of the recording mode. If the user requires the change of the recording mode, the CPU 70 issues a request to the user to determine when the extended recording is to be started. Having received information in response to the requests, the CPU 70 stores the information in the second memory 74 or on the hard disk 83. Under this condition, before the recording is started, the CPU 70 loads the information regarding the recording mode change sent from the user in the first memory 72 to determine the setting items for the recording mode change (step 1002).

Selectively, the CPU 70 can issues the question to the user at a point of time which is 35 minutes before the storage capacity of the magnetooptical disk 81 is used up such that the operation is automatically changed to the extended recording mode beginning at a point of time which is 30 before the storage capacity of the magnetooptical disk 81 is used up if the user does not positively reject the mode change. In this connection, the controller 22 is a general personal computer or the like including input devices such as a keyboard, a mouse, and a joystick, the user operates such an input device to input an answer to the question regarding selection the

recording method as an exemplary embodiment of the present invention. The input devices are well known, and hence description thereof will be avoided in this paragraph.

When the extended recording mode is not selected, the CPU records the JPEG file on the magnetooptical disk 81 in the ordinary recording mode. In the ordinary recording mode, the JPEG codec 50 generates a JPEG file using the existing compression ratio being used up to this point in response to an acquiring command (or a readout command similar thereto) shown in the upper section of Fig. 2. In this connection, since the CPU 70 recognizes the remaining storage capacity of the magnetooptical disk 81 also in the ordinary recording mode, the CPU 70 advise the user to prepare for the replacement of the magnetooptical disk 81 at a point of time which is ten minutes before the storage capacity of the disk 81 is used up (or at a plurality of predetermined points which are, for example, ten minutes and five minutes before the storage capacity of the disk 81 is used up) using an alarm, an indicator, a voice, not shown, or an interruption image to the monitor 84. If the controller 60 has two magnetooptical disk drives 80, the user must install a magnetooptical disk 81 in the other magnetooptical disk drive 80.

When it is determined that the change of the recording mode is selected in step 1002, the CPU 70

changes the mode to the extended recording mode at the specified time (steps 1006 and 1008). In the extended recording mode, the JPEG file is recorded on the magnetooptical disk 81 in the first method, the second method, or a method implemented by combining the first and second methods. The recording method allows a combination of magnitude of extension. For example, the numbers of record frames per unitary time can be set as n, m, l, and k.

Furthermore, as described above, the setting time of the extended recording mode is a point of time (for example, ten minutes before the capacity of the magnetooptical disk 81 is used up) set by the user or by the default of the CPU 70. The CPU 70 determines that the current time is corresponding to the setting time by the clock 78. Up to the setting time, the data is recorded in the ordinary recording mode (step 1004). When the extended recording mode of step 1008 is finished, processing is repeatedly executed beginning at step 1002 for a replaced new magnetooptical disk 81.

V Recording density change in extended recording mode

In the extended recording mode, data is recorded in principle in the ordinary recording mode, and the extended recording mode is adopted at a point of time near the replacement of the disk to minimize a data loss which takes place when the disk replacement is not appropriately conducted. However, it is also

possible that in the contrary fashion, data is recorded in principle in the extended recording mode, and the mode is changed to the ordinary recording mode or a mode with a recording density higher than that of the extended recording mode in a particular case.

The inventors of the present invention completely discussed the intermittent recording method. First, the inventors discussed an extended recording method in which the pertinent operation is started at a predetermined setting time as indicated by step 1006 of Fig. 7 or at a first point of the processing. In the intermittent recording method, regardless of presence or absence of an alarm signal sent from the alarm 12 to indicate occurrence of an event, an object image is recorded at a fixed interval or time or with a number of frames per unitary time beforehand defined by the user. However, in the recording method, information after occurrence of the alarm signal is treated in almost the same way as for information before occurrence thereof. This consequently leads to a drawback of insufficient information recorded after occurrence of the event.

Next, the inventors of the present invention discussed an extended recording method started using an alarm signal as a trigger. In this case, when an alarm signal is sent from the alarm 12 to the controller 60, the mode is changed to the ordinary recording mode (step 1004; or to a mode with a recording density

higher than that of the extended recording mode), and the ordinary recording mode is adopted until the alarm signal is transmitted (step 1008). In the recording method, assuming occurrence of an alarm signal as occurrence of an event, the intermittent recording is started using the alarm signal as a trigger. This method hence has an advantage that the recording density is increased after occurrence of the alarm signal to thereby improve the drawback accompanying the intermittent recording method described above. However, the inventors recognized that before occurrence of an alarm signal, an event already occurred in an actual situation, and hence if the alarm signal is used as the trigger, video at the point of occurrence of a crime and video before and after the point of occurrence of the crime cannot be recorded. For example, in a case in which an alarm signal is generated when it is detected that a suspicious person enters a monitored region, the suspicious person already conducted an act of crime to enter the monitored region at occurrence of an alarm signal and hence images in which the suspicious person conducts the act of crime cannot be obtained.

In this situation, since importance of data is beforehand increased at occurrence of the alarm signal, it is desirable to increase the data recording density (to a maximum data recording density if possible) slightly before the occurrence of the alarm

signal. Referring next to Figs. 8 to 10, description will be given of a recording method in which the data recording density is increased slightly before the occurrence o the alarm signal. Fig. 8 is a flowchart of a recording method which is executed by the CPU 70 of the surveillance system 100 shown in Fig. 1.

According to the recording method as an exemplary embodiment of the present invention, data of a monitored object is sent from the surveillance camera 10 via the video decoder 16 to the JPEG codec 50. Thereafter, the JPEG codec 50 sends output data therefrom to the first memory 72. The output data is once stored in the memory 72 and is delayed thereby. The delayed data is converted by the CPU 70 into a JPEG file to be supplied from the first memory 72 to either one or both of the magnetooptical disk drive 80 and the hard disk drive 82. In this connection, for simplicity of explanation, the data is supplied from the first memory 72 to the magnetooptical disk drive 80 in the description below. When the output from the first memory 72 is supplied to the hard disk drive 82, it is only necessary to replace the magnetooptical disk drive 80 with the hard disk drive 82 in the description. As above, the first memory 72 temporarily stores the compressed data string sent from the JPEG codec 50 to delay the compressed data string. Furthermore, the compressed data string stored in the first memory 72 contains information larger in quantity than associated

information recorded on the magnetooptical disk 81, which will be described later. As a result, a delay time (margin in time) in which the data is sent from the memory 72 to the magnetooptical disk drive 80 makes it possible that the data temporarily stored in the first memory 72 is selected/edited and part or all of the data is transferred to the magnetooptical disk drive 80.

Next, description will be given of a recording method as an exemplary embodiment of the present invention. The recording method has, as shown in Fig. 8, an ordinary extended recording mode used after the controller 60 of the surveillance system 100 is powered until an alarm signal from the alarm 12 is inputted to the controller 60 and a detailed recording mode started after the alarm signal is inputted to the controller 22 (step 1102). In this connection, the user of the controller 60 can change the recording mode by operating an input device such as an operation panel, a keyboard, or a mouse, not shown (that is, the CPU 70 can also change the mode regardless of the alarm signal). As a result, after a shooting operation of an event (such as an act of crime) is completed, the surveillance system 100 can be reset from the detailed recording mode to the ordinary extended recording mode.

Referring next to Fig. 9, description will be given of the ordinary extended recording mode. In this connection, Fig. 9 is a flowchart for explaining the

ordinary extended recording mode as an exemplary embodiment of the present invention. Incidentally, regardless of the flowchart shown in Fig. 9, when the alarm 12 supplies an alarm signal as an interruption signal to the controller 60, the CPU 70 controls the respective components such that the ordinary recording mode is terminated to be changed to the detailed recording mode. Since any interruption control well known in the pertinent technical field can be used, detailed description thereof will be omitted in this paragraph.

The ordinary extended recording mode is a recording mode adopted by the surveillance system 100 until an alarm signal is supplied from the alarm 12 to the controller 60, and either one of the continuous recording modes described above can be adopted. However, in the flowchart shown in Fig. 9, it is necessary to particularly pay attention to a point that data is delayed by the first memory 72. More specifically, the ordinary extended recording mode is adopted, for example, in a situation in which the surveillance camera 10 monitors an object in a state without any particular event, in a case of a reserved recording operation in which the recording is started when a timer (not shown) indicates arrival of a reserved time (for example, 6 p.m. at which the working hours end); in a case in which a recording operation is in a wait state (standby) waiting for an alarm signal,

or in a case (in which data is recorded from the first memory 72 onto the magnetooptical disk 81), which will be described later.

In the ordinary extended recording mode, when the surveillance camera 10 monitors a monitored object (an object to be shot by the camera 10) to send monitored information via the JPEG coded 50 to the first memory 72, the video interval time or a number of frames Fr per unitary time is set to be equal to or more than a recording period of time or a number of frames Fu per unitary time, which will be described later, specified by the user in an operation to record data outputted from the first memory 72 onto the magnetooptical disk 81 (step 2002).

The relationship Fr ≧ Fu is reversed in the relationship with respect to the interval of time. In this embodiment, the maker writes the relationship in the control program or the system parameter to be stored in the second memory 74 or on the hard disk 83. In the present invention, the user may also change or set the relationship. Furthermore, the video period of time or the number of frames per unitary time for the JPEG codec 50 to capture digital image data from the video decoder 16 is set to be equal to the video period of time or the number of frames per unitary time as Fr for the first memory 72 to capture digital image data (compressed data string) from the JPEG codec 50. However, in the present invention, the value may vary

from each other depending on cases. In such a case, Fr represents the video period of time or the number of frames per unitary time for the first memory 72 to capture digital image data from the JPEG codec 50.

The value of Fr is favorably set to be equal to a minimum interval of time or a maximum number of frames Fm per unitary time for the recording operation of the surveillance system. By this setting, it is possible to prevent any loss of images of the object shot by the camera. The value of Fm is determined according to, for example, performance of the JPEG codec 50 and the first memory 72. For example, in a state of Fm < Fr, information with a quantity less than a maximum recordable information quantity of the first memory 72 per unitary time is supplied to the first memory 72 per unitary time, and hence the first memory 72 is not operating with maximum performance. Moreover, in a state of Fm > Fr, information with a quantity more than a maximum recordable information quantity of the first memory 72 per unitary time is supplied to the first memory 72 per unitary time, and hence the first memory 72 cannot store all information received. Therefore, for example, it is favorable to write digital image data in the first memory 72 with Fm = Fr = 30 frames per second.

When the recording capacity of the first memory 72 is used up, in other words, until the first memory 72 becomes full of data, the CPU 70 stores

digital image data from the JPRG codec 21 in the first memory 72 (step 2004). When it is determined that the first memory 72 becomes full of data (step 2004), the CPU 70 records digital image data from the first memory 72 onto a magnetooptical disk 81u as a storage medium at a rate of Fu (e.g., ten frames per second) in a sequence of time beginning at the oldest data (step 2006). It is to be understood that in the ordinary extended recording mode, the digital image data is thinned out at a rate of 20 frames per second in the recording thereof from the first memory 72 onto the magnetooptical disk 81 of the magnetooptical disk drive 80. As above, such a thin-out operation is allowed for the following reasons. The ordinary extended recording mode is disposed to be used for the shooting operation in a state in which a particular event does not occur and hence data is less important; consecutive image data items contain substantially the same information between a lapse of quite a short period of time and hence even if such information is omitted, the resultant information is not adversary influenced; and although image data in a short period of time is lost in the surveillance system 100, the overall recording time is elongated. Moreover, it can be understood that the digital image data is delayed for the storage capacity of the first memory 72.

Incidentally, since the values of Fm, Fr, and Fu are only exemplarily indicated, attention is to be

made to possibility of setting as Fu = Fr. Furthermore, step 2006 includes a case in which the number of record frames per unitary time is set to zero. In this case, data is not recorded on the magnetooptical disk 81 in the ordinary extended recording mode, and the digital image data of which the quantity is equal to the storage capacity of the memory 72 is only temporarily kept therein.

Next, the detailed recording mode will be described by referring to Fig. 10. In this connection, Fig. 10 is a flowchart for explaining a detailed recording mode of the recording method as an exemplary embodiment of the present invention. The detailed recording mode is a mode adopted by the surveillance system after an alarm signal is supplied from the alarm 12 to the controller 60. The alarm 12 generates an alarm signal, for example, in response to a sense signal of a sensor, not shown, having detected an event that a suspicious person enters its monitor region. The alarm 12 then transmits the alarm signal to the interface 64 connected to the PCI bus 62 of the controller 60. As a result, the CPU 70 of the controller 60 recognizes the alarm signal. As above, the detailed recording mode is a recording mode adopted at occurrence of an event such as an event of crime.

In response to the alarm signal, the CPU 70 controls the selector 14 to select the surveillance camera 10 near the suspicious person such that the

camera tries to identify the suspicious person. Selectively, the selector 14 may supply information of a place of the suspicious person to the surveillance camera 10 to change and/or to adjust a direction and a focusing condition of a lens of the surveillance camera 10. The image shot by the surveillance camera 10 is represented, for example, by a plurality of consecutive frames successive in a time series fashion, each frame having a rectangular contour of 240 vertical pixels by 720 horizontal pixels.

Information from the surveillance camera 10 is inputted to the video decoder 16 with a correspondence established between the information and the pertinent camera by the selector 14. Subsequently, for convenience of explanation, attention will be given only to information from one video camera 10 in the description below. An analog composite signal sent from the surveillance camera 10 is converted by the video decoder 16 into a digital image and is sent to the JPEG codec 50. The CPU 70 can control the capturing of the image data by the JPEG codec 50 using the control program of the system parameter.

Although the detailed recording mode also uses steps 2002 and 2006 described above, step 2006 is replaced with step 2008. Step 2008 executes at least two operations. These operations are favorably executed at the same time. However, the present invention also covers a case in which either one

thereof is executed. Furthermore, these operations can also be used even when the number of record frames per unitary time is set to zero in the ordinary extended recording mode.

First, in step 2008, digital image data which has been recorded in the first memory 72 and of which the amount is equivalent to a predetermined period of time before occurrence of an alarm signal is written on the magnetooptical disk 81 at a time. In this embodiment, there is conducted, in place of an operation to output the digital image data from the JPEG codec 50 to the magnetooptical disk drive 80, operation in which the data from the JPEG codec 50 is once stored in the first memory 72 and then the data is outputted from the first memory 72 to the magnetooptical disk drive 80. Therefore, the first memory 72 conducts a function of a buffer to delay the recording operation of the digital image data on magnetooptical disk 81. This makes it possible to record data before the alarm signal, which cannot be recorded in the prior art.

For example, in a situation, when an alarm signal is generated at detection of an event in which a suspicious person enters a monitored region, before the alarm signal is generated, an event of crime that a suspicious person enters a monitored region has already occurred. Consequently, in the first method of the intermittent video recording method in which the

recording is started using an alarm signal as a trigger, images in which the suspicious person conducts the act of crime cannot be obtained. However, in the recording method of the present embodiment, data of a predetermined period of time before occurrence of the alarm signal can be also recorded. Therefore, it is possible to obtain, for example, an image at a point of time of a criminal act when a suspicious person breaks a window to enter a place.

The predetermined period of time before occurrence of the alarm signal depends on the storage capacity of the first memory 72. For example, when the first memory 72 can store digital video data of 600 frames, the period of time is a delay time, e.g., 20 seconds for data corresponding to 600 frames. Therefore, in this situation, digital video data before occurrence of the alarm signal can be recorded on the magnetooptical disk 81 for at most 20 seconds. Since the digital video data for at most 20 seconds in the past can be stored, the user can set a particular period of time within the range of 20 seconds to set the period to the system. It is to be understood that by increasing the capacity of the first memory 72, the predetermined period can be adjusted.

Second, after the occurrence of the alarm signal, the CPU 80 sets Fu to a value (Fu') larger than the value of Fu in step 2006 shown in Fig. 3, favorably to the value of Fr, and more favorably as Fu = Fr = Fm.

As described above, by reducing difference between Fr and Fm, the contents of the digital image data are rarely lost before the digital image data is stored in the first memory 72. In step 2006 as described above, since the digital image data is recorded from the first memory 72 onto the magnetooptical disk 81 at the rate Fu, the data is thinned out. In contrast thereto, in step 2008 shown in Fig. 10, since the image data after occurrence of an alarm signal is more important than the image data therebefore, the data recording density is increased to prevent loss of information.

Referring next to Fig. 11, description will be given of an advantage of the recording method of the present invention. In this connection, Fig. 11 is a schematic diagram with respect to lapsed time in the recording method according to the present invention. Fig. 11 shows an advantage of the recording method of the present invention in terms of a recording time, not the number of frame. However, according to the disclosure of the present invention, it is possible for those skilled in the art to easily replace the recording time with the number of frames. In Fig. 11, ΔT_1 is a minimum interval of time corresponding to Fm for the recording operation in the surveillance system 100. To is a point of time when the controller 22 receives an alarm signal from the alarm 12. The controller 60 can obtain an event occurrence time To, for example, from the clock 78. Ta is a video

recording period of time after detection of a alarm signal. Ta is set by the user and corresponds to Fu' described above. Tb is a video recording period of time immediately before detection of an alarm signal. Tb is set by the user and is at most Tm. Tm is the maximum video recording period of time for the recording of data in the first memory 72 in the past (this corresponds, for example, 20 seconds above). Moreover, Tc is a video recording interval of time set by the user. In relation to the method of the present invention, Tc is a video recording interval of time before detection of an alarm signal and corresponds to Fu.

Case (B) shows an extended recording method started always at a predetermined setting time or at a predetermined setting time. Regardless of presence/absence of an alarm signal, an image of an object is intermittently or continually recorded for a period of time of Tc. In the recording method of case (B), images before and after time T_0 cannot be recorded. Furthermore, it is to be understood that the video recording density is low after time T_0, and hence there occurs considerable loss of necessary information.

In case (C), data is recorded in the extended recording mode before occurrence of an alarm signal, and after occurrence thereof, the user changes the recording period of time Tc to an available value, i.e., a fixed period of time of Ta seconds to change

the mode to a mode with a higher recording density or to the ordinary recording mode. Therefore, in the recording method of case (C), the surveillance system 100 can record video at a minimum interval time available for the recording of the surveillance system 100 after occurrence of an alarm signal. This method can minimize the loss of information after time To when compared with case (B). However, since data is recorded at the fixed interval of time Tc before occurrence of an alarm signal, there may occur a case in which quite important images for a short period of time cannot be recorded.

The recording method of the present embodiment corresponds to case (A). Images shot by the surveillance camera 10 are stored in the first memory 72 in any situation at a minimum interval of time ΔT_1 (seconds) available for the surveillance system 10. Before occurrence of an alarm signal, the digital image data is recorded on the magnetooptical disk 81 at a fixed interval of time of Tc seconds set by the user (that is, in the ordinary extended recording mode). However, by automatically changing the video recording interval of time Tc beforehand set by the user to the recording interval of time ΔT_1 seconds, video data from -Tb (seconds) to relative to a point of time T0 at which the controller 60 receives an alarm signal to +Ta seconds relative thereto is completely recorded on the magnetooptical disk 81 (detailed recording mode). As a

result, an image of quite an important image at a point of time and images before and after the point of time can be completely recorded on the magnetooptical disk 81, and the capacity of the magnetooptical disk 81 can be efficiently consumed. This leads to realization of the surveillance operation for a long period of time. In Fig. 11, Ta + Tb corresponds to Tm. Incidentally, although Fig. 5 does not shown a recording density after a point of time of T_0 + Ta, the recording density is favorably higher than Tc. More favorably, in place of the operation to intermittently record images of an object, the images are completely recorded on the magnetooptical disk 81 at a recording interval ΔT_1 (seconds).

In this embodiment, depending on presence/absence of an alarm signal, the recording mode is divided into two modes, namely, the ordinary extended mode and the detailed recording mode. However, it is to be understood that the detailed recording mode can be further divided into many stages of modes according to a plurality of alarm signals and other alarm information in a plurality of stages. Additionally, the control program can be set such that regardless of presence/absence of an alarm signal, the detailed recording mode is used by a user option or by the default of the CPU 70. For example, the ordinary extended recording mode is used within the working hours or in a case in which the guard watches the

monitor 84 in an online fashion, which will be described later, and the detailed recording mode is used in any other cases. This applies not only to this embodiment but also to all other variations, which will be described later.

Next, description will be given of another embodiment of the present invention. According to a recording method of the embodiment, in the detailed recording mode, the compression ratio used in the JPEG compression/decompression algorithm is set to a value lower than that of the compression ratio ordinarily used in the prior art (that is, the ordinary extended recording mode) to thereby increase the amount of information recorded on the magnetooptical disk 81. For example, a compression ratio of 1/20 in the prior art is changed to a compression ratio of 1/15. This prevents loss of information after occurrence of an event. The CPU 72 can freely set the compression ratio by the control program as described above.

Whether or not the recording method of the embodiment is adopted or whether or not the recording method of this embodiment is combined with the recording method of the embodiment described above can be specified as a user option. In other words, it may be possible in the recording method of the present embodiment that a step to set the compression ratio to a value smaller than that of the compression ratio in the extended recording mode is disposed as, for

example, step 2001 before step 2002 shown in Fig. 9 to configure a detailed recording mode including a flow of steps 2001, 2002, 2004, and 2006. Alternatively, it is also possible to disposed step 2001 before step 2002 shown in Fig. 10 to configure a detailed recording mode including a flow of steps 2001, 2002, 2004, and 2008.

The recording method of the present embodiment prevents loss of data by reducing the compression ratio. According to a sequential DCT operation, a point of image data and another point quite near the point are assumed to be equal or similar in data to each other. By achieving a Fourier transform for a scalar quantity of a point of an image to convert the scalar quantity into a power spectrum along a frequency axis, any power spectrum at a frequency equal to or more than a particular frequency is regarded as zero. By regarding the spectrum as zero, associated data is removed. This corresponds to "data compression". Therefore, when a data string compressed by the sequential DCT operation is expanded, the original image is not completely replayed, that is, the decompressed data includes a loss. By reducing the compression ratio, the data loss becomes smaller in general.

In the embodiment, the recording mode and/or the compression ratio are/is changed by an alarm signal. However, the digital recording method of the present invention is also applicable to other than the

surveillance system, and hence it is natural that the signal used as the trigger is not limited to the alarm signal. Moreover, although the digital image data is delayed by the first memory 72 in the embodiment, such a delay function can be naturally achieved by other members such as a frame buffer and any other buffer member.

V Continuous recording method

Next, description will be given of a continuous recording method to prevent data loss in association with the replacement. The CPU 70 receives compressed data string from the JPEG codec 50 to create a JPEG file, once stores the JPEG file in the first memory 72, and then transfers the JPEG file therefrom to the magnetooptical drive 80 for the recording thereof. However, since the JPEG file data transferred has data exceeding the storage capacity of a magnetooptical disk 81, the user must replace the magnetooptical disk 81. To prevent an event in which the JPEG file is not recorded during the replacement of the magnetooptical disk 81, the control program stored in the second memory 74 controls the recording operation according to a control procedure of Fig. 12 or 13. In this connection, Fig. 12 shows an example of a control flowchart regarding the continuous recording executed by the CPU 70. Additionally, Fig. 13 shows another example of a control flowchart regarding the

continuous recording executed by the CPU 70.

In the embodiment, it is assumed that a transfer rate of the JPEG file is Ti (bytes/second), a storage capacity of each magnetooptical disk 81 is Cr (bytes), and a transfer rate of the magnetooptical disk drive 24 is Tr (bytes/second). Moreover, it is assumed that a storage capacity of the hard disk 83 is Ca (bytes) and a transfer rate of the hard disk drive 82 is Ta (bytes/second). In this embodiment, "transfer rate" is a mean transfer rate including overhead such as time required for command issuance, positioning, and latency. Furthermore, it is assumed in the embodiment that the following expressions hold.

$$Tr > Ti$$
$$Ta > Ti$$

V-1 Recording in which time-series property of data does not completely correspond to increase of addresses

Referring to Fig. 12, the control program stored in the second memory 74 controls the switching circuit 75, the second interface 66, and the magnetooptical disk drive 80 to record the JPEG file on a magnetooptical disk 81 (step 1202). Incidentally, as described above, when the recording is started by an alarm signal, a step to determine whether or not an alarm signal is already received is disposed in a stage before the start of Fig. 8. In this situation, assume

that this state is referred to as "phase 1".

In phase 1, a data stream of the JPEG file is sequentially inputted via the second interface 66 to the magnetooptical disk drive 80 at a transfer rate of Ti (bytes/second). If the magnetooptical disk 81 has a remaining storage capacity of Crr (bytes), the JPEG files can be recorded thereon for a period of time of t1 (seconds) until the magnetooptical disk 81 becomes full of data. In this regard, t1 is defined by the following expression.

$$t1 = Crr/Ti$$

Next, the control program controls respective sections such that the switching circuit 75 changes the input destination of the JPEG file from the magnetooptical disk drive 80 to the hard disk drive 82 before the magnetooptical disk 81 becomes full of data (step 1204). Assume that processing after this point is referred to as "phase 2". Moreover, the CPU 70 simultaneously instructs the monitor 84 and a display (not shown) and/or a loudspeaker (not shown) to advise the user to replace the magnetooptical disk 81 (step 1206). In this situation, the control programs reserves a time of tc (seconds) for the user to replace the magnetooptical disk 81 (step 1208).

After lapse of the disk replacement time tc (step 1208), the control program again changes the

input destination of the JPEG file from the hard disk drive 82 to the magnetooptical disk drive 80 and also reserves a data path from the hard disk drive 82 to the magnetooptical disk drive 80 (step 1210).

In phase 2, the magnetooptical disk 81 stores thereon the JPEG file transferred from the first memory 72 and data accumulated on the hard disk 83 during the disk replacement. A data stream including data from the JPEG codec 2 and data from the hard disk drive 26 is inputted to the magnetooptical disk 81, the respective data items being alternately inputted in the unit of one byte or a desired number of bytes. The control program can beforehand determine the number of bytes to be alternately inputted. A capacity of data Ct (bytes) accumulated in the hard disk drive during the disk replacement is represented by the following expression.

$$Ct = Ti \cdot tc$$

For this expression, the hard disk storage capacity Ca must satisfy expression (8) below.

$$Ca \geqq Ti \cdot tc$$

A transfer rate Tc from the hard disk drive 82 to the magnetooptical disk drive 80 is expressed as follows.

$$Tcmax = Tr - Ti$$

$$Tcmin = Ti^2 \cdot tc/(Crr - Ti \cdot tc)$$

The maximum value of Tc, i.e., Tcmax (bytes/second) is determined by the transfer rate of the magnetooptical disk drive 80. The minimum value of Tc, i.e., Tcmin (bytes/second) is restricted by a condition that the data accumulated on the hard disk 83 during the disk replacement must be completely copied before the magnetooptical disk 81 becomes full of data.

Incidentally, a condition that the copy starts with the transfer rate Tcmin and the copy from the hard disk 83 onto the magnetooptical disk 81 is completed when the magnetooptical disk 81 becomes full of data is represented by the following expression.

$$Crr = Ti \cdot tc + (Ti \cdot tc) \cdot Ti/Tcmin$$

By obtaining Tc from expression (11), expression (10) can be attained. To operate the magnetooptical disk drive 80 with maximum performance, the transfer rate Ta of the hard disk drive 82 must satisfy the following expression (12).

$$Ta \geqq Tr - Ti$$

Although expression (12) does not indicate a

limit value possible for the control method, the hard disk drive 82 must satisfy the following expression (13).

$$Ta \geqq Tcmin(Ti^2 \cdot tc)/(Crr - Ti \cdot tc)$$

When the copy from the hard disk 83 onto the magnetooptical disk 81 is completed (step 1212), the data path from the hard disk drive 82 to the magnetooptical disk drive 80 is interrupted (step 1214). As a result, processing returns to phase 1 (step 1202), and the operation is repeatedly executed to achieve the continuous recording. In this connection, when processing returns from step 1212 to step 1202, information from the hard disk 83 is already recorded on the magnetooptical disk 81. However, it is assumed that the CPU 70 can monitor the time t1 to be lapsed before the magnetooptical disk 81 becomes full of data by calculating, using the clock 75 and the like, a capacity of information already accumulated.

Since the input data sequence of the JPEG file is not recorded on the magnetooptical disk 81 at addresses in a time series fashion, the data sequence must be adjusted by the software in the data reading operation. For example, by using software to sequentially read data from the JPEG files beginning at the oldest data with respect to time, the JPEG files are read in a time series fashion and hence image data

is appropriately ordered. It is easy for those skilled in the art to prepare such software, and hence detailed description of specific contents thereof will not avoided in this paragraph.

Although not particularly indicated in the flowchart shown in Fig. 12, the processing is in principle terminated when the data input of compressed data from the JPEG codec 50 is finished or the data transfer from the first memory 72 is finished. For example, when the data input from the JPEG codec 50 is finished when processing is in step 1202, the CPU 70 notifies the condition via the monitor 84 or a display or the like, not shown, to the user and then terminates the recording operation. When the data input from the JPEG codec 50 is finished when processing is in step 1204 or 1210, the CPU 70 notifies, when step 1212 is terminated, the condition via the monitor 84 or a display or the like, not shown, to the user and then terminates the recording operation.

V-2 Recording in which time-series property of data completely corresponds to increase of addresses

Next, referring to Fig. 13, description will be given of a control method regarding another continuous recording in accordance with the present invention. The control method differs from that shown in Fig. 12 and makes it possible that the time-series sequence of data inputted to the system corresponds to

addresses at which the data is recorded. Consequently, software employed for the replay need only read information in an address sequence and hence becomes simpler than the software used in Fig. 12. However, the information recorded in this control method is ordered at addresses in a sequence of recording time. Therefore, even if the software used by the control method of Fig. 12 is employed, the data can be appropriately read from the disk.

Steps 1202 to 1208 of the control method shown in Fig. 13 are substantially equal to those shown in Fig. 12 and hence detailed description thereof will be avoided. Consequently, expressions (1) to (5) used by the control method of Fig. 12 are also similarly employed by the control method shown in Fig. 13. However, it is assumed in the control method shown in Fig. 13 that step 1202 is called "phase 1", steps 1204 to 1208 are called "phase 2", and step 1122 and subsequent steps are called "phase 3".

Incidentally, according to the control method shown in Fig. 9, after a lapse of the disk replacement time tc (step 1208), it is typical that a data path from the hard disk drive 82 to the magnetooptical disk drive 80 is reserved while keeping a data path from the first memory 72 to the hard disk drive 82 (step 1222). The processing is different in this point from step 1210 in which the magnetooptical disk drive 80 receives data from both of the first memory 72 and the hard disk

drive 82. As a result, while continuously receiving the JPEG file from the first memory 72, the hard disk drive 82 outputs, to the magnetooptical disk drive 80, the data stored on the hard disk 83 during the magnetooptical disk replacement and data inputted thereafter. Thereafter, all data of the hard disk 83 must be copied onto the magnetooptical disk 81 before the magnetooptical disk 81 becomes full of data. In this operation, the transfer rate Tc must satisfy the following expression.

$$Tc \leqq \min(Tr, Ta)$$

In the expression, min(Tr,Ta) represents a smaller one of Tr and Ta. Assume that a capacity of C(t) is already recorded on the hard disk at time t (seconds) after the data transfer to magnetooptical disk is started. Then, the following expression holds.

$$C(t) = (Ti - Tc) \cdot t + Ti \cdot tc - (Ti - Tc) \cdot tc =$$
$$= (Ti - Tc) \cdot t + Ti \cdot tc$$

In the expression, Tc is restricted by the following expression.

$$Ti < Tc \leqq Ta - Ti$$

Assume that a period of time tcc (seconds) is

required to copy all data of the hard disk 83 onto the magnetooptical disk 81. This corresponds to time t for C(t) = 0 in expression (15) and hence tcc is expressed as follows.

$$tcc = (Tc \cdot tc)/(Tc - Ti)$$

Since the magnetooptical disk 81 must not become full of data during the period tcc, the following expression is required to be satisfied.

$$\{Tc \cdot tc/(Tc - Ti) - tc\} \cdot Tc \leqq Crr$$

In expression (18), tc is subtracted because no data is transferred to the magnetooptical disk 81 since the magnetooptical disk 81 is being replaced during the period of time tc. According to expression (18), Tc is restricted by the following expression.

$$Tc \geqq Crr \cdot Ti/(Crr - Ti \cdot tc)$$

As a result, to implement the control method, it is necessary to satisfy expression (16) and (19). In this way, all data recorded on the hard disk 83 can be copied onto the magnetooptical disk 81, and immediately after the end of copy, the data path from the hard disk drive 82 to the magnetooptical disk drive 80 is interrupted and the data input destination is

changed at the same time from the hard disk drive 82 to the magnetooptical disk drive 80 (step 1226). Resultantly, processing returns to step 1102 of phase 1 and then the processing is repeatedly executed to achieve the continuous recording.

Additionally, although not particularly indicated in the flowchart shown in Fig. 13, the processing is in principle terminated when the data input a compressed data string from the JPEG codec 50 or the transfer from the JPEG file from the first memory 72 is finished. For example, if the data input from the JPEG codec 50 is finished when the processing is in step 1202 or 1226, the CPU 70 notifies the condition via the monitor 84 or a display or the like, not shown, to the user and then terminates the recording operation. If the data input from the JPEG codec 50 is finished when processing is in step 1204 or 1222, the CPU 70 notifies, when step 1224 is terminated, the condition via the monitor 84 or a display or the like, not shown, to the user and then terminates the recording operation.

In concurrence with the recording, information of the video camera 10 may be displayed on the monitor 84. The monitor 84 may, for example, divide its screen into partitions as many as there are video cameras 10 so that information items of all cameras are displayed one monitor. Or, an equal number of monitors 84 and video cameras 10 may be installed.

The monitor 84 may be installed immediately near the controller 60 or may be installed in another room separated therefrom. Incidentally, when the monitor 84 displays images from the cameras in the divided screens, the relative display position between the respective divided screens can be set using the frame buffer 58. For example, when the entire screen is divided into four screen partitions, the partitions may be arranged in a shape of a rectangle with a vertical length of two partitions and a horizontal length of two partitions, a rectangle including four partitions in the horizontal direction, or a rectangle including four partitions in the vertical direction.

To decompress a JPEG file stored on a magnetooptical disk 81, the user first installs a magnetooptical disk having stored a desired JPEG file thereon in the magnetooptical disk drive 80. Next, the CPU 70 sends, according to the control program, the JPEG file to the JPEG codec 50. The JPEG codec 50 decompresses the JPEG file sent thereto according to a decompression ratio described in a quantization table definition (DQT) marker of the JPEG file and then transmits the decompressed file in the form of digital image signals to the video encoder 18. Furthermore, the CPU generates, according to the control program, filter data using information of an extracted comment marker and then sends the filter data to the adaptive output digital filter 40 of the DSP 40.

The JPEG codec 50 decompresses the JPEG file sent thereto and transmits the decompressed file to the adaptive output digital filter 40. In the filter 40, the filter data analyzer 42 acquires information of Bi, Ds, and Di - Ds and determines whether or not the data is allowed to pass the peaking file 46. The switching circuit 48 outputs Bi via the peaking file 46, and outputs Bj directly therefrom to transmit these items as image data to the video encoder 18.

The video encoder 18 encodes the digital image signals outputted from the output filter 40 into analog composite signals and sends the signals to the monitor 84 to display an image thereof on the monitor 84. Incidentally, in the system 100, to guarantee continuous display of camera information, it is desirable to install a playback dedicated monitor 84. Moreover, since the control program has also a software function to edit screens of the monitor 84 (playback, fast forward, rewind, magnification, minimization, rotation, etc.), the user of the controller 60 can confirm and edit desired image information.

Incidentally, the control program of the present invention can similarly recognize a JPEG file created using Ds different from the Ds described above and a JPEG file of the prior art in which the comment marker does not include Bi and the like. Therefore, as Ds used by the output filter 4, Ds set by the input filter 1 is not always directly used. That is, Ds sent

from the JPEG file processor 120 (control program) is used. When the comment marker does not include information such as Bi and the like, the peaking filter 46 does not operate, and the switching circuit 48 operates such that the output from the JPEG codec 50 directly becomes the output from the output filter 40 of the DSP 20.

Additionally, since the JPEG codec 50 such as MD2310 described in the embodiment also has a control function of the frame buffer 58, all data flow regarding the JPEG codec 50 passes the frame buffer 58. Therefore, in addition to a raster/block conversion necessary for compression/decompression, functions such as control of image display positions, magnification of an image, and minimization thereof are also achieved using the JPEG codec 50.

In the present embodiment, a block of 8 pixels by 8 pixels is used as a reference to divide the input image. It is to be appreciated that the present invention is not restricted by this embodiment. Additionally, there may be disposed a plurality of lowpass filters having different threshold values. Furthermore, the use of the present invention is not limited to the surveillance system. It can be understood by those skilled in the art that the present invention is applicable to various uses such as high-resolution photographs and the editing of an animated cartoon by a computer.

Furthermore, in the present invention, an image is formed in the JPEG format. However, it is to be understood that the surveillance system 100 as an exemplary embodiment of the present invention is applicable also to any other format (e.g., a GIF format). Therefore, the surveillance system 100 can be applied to any image compressing/decompressing device other than the JPEG codec.

Moreover, in accordance with the continuous recording method as an exemplary embodiment of the present invention, data is recorded using one removable recording medium drive such that when removable recording medium thereof is replaced, data is temporarily recorded on a fixed disk of a fixed disk driver. Thereafter, the data recorded on the fixed disk is transferred to a new removable recording medium replaced as above to thereby achieve continuous recording of data. It is therefore to be understood by those skilled in the art that any recording method other than those of Figs. 12 and 13 can be employed only if the advantage is obtained. Furthermore, it is to be appreciated that the continuous recording system of the present invention is not restricted by the image data recording.

VI Automatic setting and update method for system parameter and control program

Referring next to Figs. 1, 14, and 16,

description will be given of an automatic setting and update method for system parameters and control programs of the present invention. Incidentally, Fig. 14 is a general block diagram for explaining an automatic setting and update method for system parameters and control programs as an exemplary embodiment of the present invention. Fig. 15 is a flowchart primarily according to an in-execution control program 142 executed by the CPU 70. Fig. 4 is a program primarily based on an in-execution update program 152 shown in Fig. 1 to be executed by the CPU 70.

The hard disk 83 of this embodiment stores a system parameter file 144 and a control program file 154 as shown in Fig. 1. Moreover, the hard disk 83 (or the second memory 74 as an alternative unit) stores an update program 152. In addition, selectively, the hard disk 83 contains an identifier (ID) check program 164 shown in Fig. 1. The identifier check program 164 conducts collation of identifier data 172 stored, for example, on the magnetooptical disk 81. If the identifier data 72 is other than predetermined data, the program 164 rejects data communication with the magnetooptical disk 81 or notifies the condition via a display, not shown, to the user.

In Fig. 14, although the control program 142 is substantially the same as the control program file 154, different reference numerals are assigned thereto

to clearly indicate that the control program 142 is being executed by CPU 70. The update program 152 is a program used to set and to update the control program 154. The update program 152 is disposed since the control program 154 can neither set not update its own contents.

The system parameter 144 represents, as described above, operation environments such as an image compression ratio used by the JPEG codec 50, a recording time set when an alarm signal is received from the alarm 12, a switching sequence and a switching interval of the monitor cameras 10 by the selector 14, a recording interval of frame, and an image capturing interval. The system parameter 144 includes a flag 144a. The flag 53a identifies a condition that the system parameter 53 is entirely updated or is updated for each operation environment condition. When these operation environments are required to be set or changed, the system parameter 144 is individually set or updated by the user or is entirely set or updated by an automatic setting and update program, which will be described later.

Assume, for example, in a case in which the system includes three surveillance cameras (first to third surveillance cameras 10, not shown), the camera changing operation is sequentially conducted as from first camera 10 to the second camera 10, from second camera 10 to the third camera 10, and from third camera

to the first camera. Even when the maker of the surveillance system 100 configures the system parameter to change the camera 10 at an interval of three seconds, if the user considers that an object of the third is particularly important, only the interval of time to change operation from the third camera to the first camera can be set to, for example, six seconds. Since such an individual change (customization) is attended with a fear that the time of six seconds is restored to three seconds thereafter by the automatic update program for the system parameter 144, the user sets the flag 144a such that the flag 144a cannot be updated. By this setting, the user can keep the setting of six seconds. The setting of this kind is convenient, for example, to discriminate a surveillance system of a floor for shops of high-quality articles such as a jewelry shop of a department store from a surveillance system of a floor for shops only for inexpensive articles of a relatively lower price, i.e., only food stuffs. Furthermore, by notifying the condition to the maker, the user can update, in an update operation of the system parameter 144, the system parameter 144 while keeping desired setting.

It is natural that the user can set the flag 144a so that the automatic update program always updates the system parameter. The flag 144a may also be used to prevent an update program for another surveillance system or a malicious update program such

as a virus from updating the system parameter 144. That is, user identifier information which the identifier data 172 may contain is checked such that the update of the system parameter 144 is rejected if the identifier data 172 does not match predetermined information. In this connection, the identifier collation may be naturally combined, when necessary, collation of a fingerprint, a voiceprint, and/or an encryption protocol. Furthermore, when the user accesses the controller 60, the identifier may be similarly confirmed.

The control program 154 is an application program to control the respective sections. More concretely, the control program includes a hard logic control to control the JPEG codec 50 and the like, a user interface, and a disk access. The application programs to constitute the control program can be created by any well known developing tools such as Visual C++ and Borland C++, and hence detailed description thereof will be avoided in this paragraph. The control program 154 is set or updated at initialization or when a software version is improved thereafter to, for example, correct bugs in the program. In general, the control program 154 is not freely set by the user. Moreover, if the program 154 is freely changed, there exists a fear that the surveillance system 100 becomes inoperative. Therefore, the control program 154 in this embodiment

does not include a flag similar to the flag 144a. However, according to the present invention, the control program 154 may contain a flag.

Incidentally, as distinct from this embodiment in which the system parameter 144 and the control program 154 are stored on the hard disk 83, it is also possible to store the system parameter 144 and/or the control program 154 in the second memory 74.

Since the communication unit 76 is also connected to a maker of the system parameter 144 and the control program 152, the user can receive an update service thereof via, for example, an internet provider.

Subsequently, description will be given of the setting and update procedure of the system parameter 144 by referring to Figs. 1, 14, and 15. First, the user installs a magnetooptical disk 81 having stored thereon a latest system parameter file 174 in the magnetooptical disk drive 80. Incidentally, for simplification of explanation, the magnetooptical disk 81 contains identifier data 172, the latest system parameter file 174, and a latest control program 176 in this embodiment. However, at least one item thereof may be installed on a different magnetooptical disk. The magnetooptical disk drive 80 reproduces information on the magnetooptical disk 81 to send data of the information via the PCI bus 62 to the CPU 70. Or, the disk drive 80 sends, by an auto-run, data stored on the disk 81 via the PCI bus 62 to the CPU 70. First, the

CPU 70 temporarily stores received data in the first memory 72 and then conducts extraction and collation (verification) of the identifier data 172 according to the identifier check program 164 (step 1302). If the ID collation is not required, the CPU 38 notifies the condition via a display or the like, not shown, to the user and terminates the processing. This prevents an event that a system parameter file of another surveillance system or a malicious program to invalidate operation of the surveillance system 100 is replaced with the current system parameter. In this connection, the identifier collation may be executed in the magnetooptical disk drive 80.

When it is determined in step 1302 that the identifier collation is recognized, the CPU 70 operates thereafter according to the control program 142. First, the CPU 70 makes a check to determine whether or not the flag 144a to allow update of at least one operation environment is present and thereby determines whether or not the system parameter 144 can be updated (step 1304). In a case in which the user sets the flag 144a to prevent update of any operation environment, there exists no parameter to be updated. Therefore, the CPU 70 notifies the condition via a display or the like, not shown, to the user and terminates the processing.

When it is determined in step 1304 that the system parameter 53 can be updated, the CPU 70 then

determines whether or not the magnetooptical disk 81 contains the system parameter 174 (step 1306). As distinct from this embodiment, if the magnetooptical disk 81 does not contain the system parameter 174, the CPU 70 notifies the condition via a display or the like, not shown, to the user and terminates the processing.

When it is determined in step 1306 that the system parameter 174 is present, the CPU 70 then determines whether or not the current hard disk 83 contains the system parameter 144 or whether or not the system parameter 174 is younger than the system parameter 144 (step 1308). The latter determination is conducted through comparison of the creation date between the system parameters 144 and 174. When the system parameter 144 is present and the creation date of the system parameter 144 is equal to or younger than that of the system parameter 174, it is not necessary to update the current system parameter 144. Therefore, the CPU 70 notifies the condition via a display or the like, not shown, to the user and terminates the processing.

When it is determined in step 1308 that the hard disk 83 does not contain the system parameter 144, the CPU 70 copies the system parameter 174 onto the hard disk 83 to thereby set the system parameter (step 1310). When it is determined in step 1308 that the creation date of the system parameter 174 is younger

than that of the system parameter 144, the CPU 70 updates the system parameter 144 to the system parameter 174 (step 1310). When the setting or the update is finished, the CPU 70 notifies the condition via a display or the like, not shown, to the user and terminates the processing.

Next, description will be given of the setting and update procedure of the control program 154 by referring to Figs. 1, 14, and 16. First, the user installs a magnetooptical disk 81 having stored thereon a latest control program 174 in the magnetooptical disk drive 80. The magnetooptical disk drive 80 replays information on the magnetooptical disk 81 to send data of the information via the PCI bus 62 to the CPU 70. Or, the disk drive 80 sends, by an auto-run, data stored on the disk 81 via the PCI bus 62 to the CPU 70. First, the CPU 70 executes step 1302 described above.

When it is determined in step 1302 that the identifier collation is recognized, the CPU 70 makes a check to determine whether or not the magnetooptical disk 81 contains the control program 176 (step 1402). As distinct from this embodiment, when the magnetooptical disk 81 does not contain the control program 176, the CPU 70 notifies the condition via a display or the like, not shown, to the user and terminates the processing. Incidentally, the CPU 70 can execute step 1402 by the control program 142. However, when the magnetooptical disk 81 does not

contain the control program file 154, there does not exist the control program 142. Therefore, step 1402 may be achieved by the update program 152.

When it is determined in step 1402 that the system program 176 is present, the CPU 70 terminates the control program 142 and initiates the update program 152 (step 1404). Alternatively, when processing of step 1402 and succeeding steps is executed by the update program 152, step 1404 is removed. Next, a check is made to determine whether or not the hard disk 83 contains the control system 152 or whether or not the control program 176 is younger than the control program 152 (step 1406). The latter determination is conducted through comparison of the creation date between the control programs 176 and 152. When the control program 152 is present and the creation date of the control program 152 is equal to or younger than that of the control program 176, it is not necessary to update the current control program 152. Therefore, the CPU 70 notifies the condition via a display or the like, not shown, to the user and terminates the processing.

When it is determined in step 1406 that the hard disk 83 does not contain the control program 152, the CPU 70 copies the control program 176 onto the hard disk 83 to thereby set the system parameter (step 1408). Moreover, when it is determined in step 1406 that the creation date of the control program 176 is

younger than that of the control program 152, the CPU 70 updates the control program 152 to the control program 176 (step 1408). When the setting or the update is finished, the CPU 70 notifies the condition via a display or the like, not shown, to the user and terminates the processing.

As above, according to the method of the present invention, the user can entirely and automatically set and update the system parameter and the control program. Therefore, the setting and update processing can be executed in a shorter period of time and with a smaller number of mistakes of humans as compared with the prior art.

Incidentally, it is not necessary for the user to obtain the magnetooptical disk 176 having stored thereon the system parameter 174 and/or the control program 176, but the user can download such items via a communication line such as the internet, a commercial online system, or a leased line. Consequently, the present invention also covers a setting and update method for the system parameter and the control program using the communication line. In this case, it is to be understood that there exists before the steps shown in Figs. 15 and 16 a step to access a predetermined address of a site or the like of the maker for the download of the system parameter and the control program.

In a case in which the system parameter is

set and updated using the communication line, step 1302 shown in Fig. 15 is executed by, for example, an event in which the user inputs a user identifier and a secret code (a password). Moreover, step 1306 will be removed. Additionally, it is to be understood that steps 1308 and 1310 may be executed by a host computer on the maker side connected to the communication line. Furthermore, when the system program is set and updated using the communication line, it is to be appreciated that by removing step 1404 shown in Fig. 16, steps 1406 and 1408 may be executed by a host computer on the maker side connected to the communication line.

Description has been given of favorable embodiments of the present invention above. However, the present invention is not restricted by these embodiments but can be modified and changed in various ways within a scope of the present invention.

INDUSTRIAL APPLICABILITY

Since a continuous recording method and system and a continuous recording system as exemplary embodiments of the present invention can be configured in one personal computer, the required space can be minimized.

According to a digital recording method and a digital recording system as exemplary embodiments of the present invention, a point of timing to write digital data on a storage medium is delayed using a

buffer and the buffer stores therein information equal to or more detailed than information stored on the storage medium. Therefore, there is provided a margin of time by the delay of recording point of time, and information to be written from the buffer onto the recording medium can be selected and edited during the margin of time. It is hence possible to record, if necessary, information which cannot be written on the recording medium in the prior art. By applying the present system to a surveillance system, it is possible to increase reliability of the surveillance system.

According to a digital recording method and a digital recording system as exemplary embodiments of the present invention, since the amount of data recorded on a recording medium can be freely changed during the recording of the data, the period of time to record data can be advantageously elongated. Moreover, by applying the present invention to the surveillance system, information of a time zone in which data cannot be recorded in the prior art can be recorded and hence it is possible to implement a highly reliable surveillance system.

According to an image compression/ decompression system and a surveillance system as exemplary embodiments of the present invention, the mosquito noise is reduced as compared with the prior art and hence it is possible to replay images with a high quality. Additionally, since the JPEG codec of

the prior art available in the market can be used according to the present invention, the increase of the cost caused by the development of a new algorithm and the like can be prevented. When it is necessary to guarantee operation similar to that of the system of the prior art without operating the primary section of the present invention, it is only necessary to set the threshold value to a larger value. Furthermore, the surveillance system of the present invention can replay without any problem a JPEG file generated using a different threshold value and a JPEG file of the prior art with high mosquito noise.

Preferably, a JPEG file processor is disposed to write file data in a comment marker of the JPEG file. However, the JPEG file processor does not change the compressed data string of the JPEG file. Moreover, the JPEG decompressor of the prior art does not recognize information of the comment marker of the JPEG file. Or, even when the JPEG decompressor recognizes information of the comment marker, the decompressor does not use the information as reference for the decompression of the compressed data string. In consequence, a JPEG file created according to the present invention can be decompressed without any problem by the JPEG codec of the prior art.

In this case, the JPEG codec of the prior art does not recognize information described in the comment marker. Or, even when the JPEG codec recognizes

information of the comment marker, the JPEG codec does not use the information as reference for the decompression of the compressed data string. Therefore, file data of the JPEG file transferred to the JPEG codec of the prior art is not used when the JPEG file is decompressed and restored. Consequently, although the mosquito noise is decreases as compared with the prior art, a blur may take place in a contour of an image due to a lowpass filter in some cases. However, the blur or the obscured contour of the image is less effective for a sense of incongruity as compared with the mosquito noise. Therefore, even when a JPEG file created by the present invention is decompressed by the JPEG codec of the prior art, it is possible to produce an image with high quality.

Moreover, information of area having passed the lowpass filter is recorded in the comment marker. By using information of the comment marker, the blur of the image contour can be removed and a high-quality image can be produced with high fidelity to the original image. The processing can be conducted by an adaptive output digital filter including a filter data analyzing circuit and a peaking filter.

A detecting circuit, a lowpass filter, a file data analyzing circuit, and a peaking filter can be implemented as one digital signal processor. This minimizes the cost and the space necessary for the system when compared with a configuration including

respectively separated constituent components.

According to an automatic setting and update program for the system parameter and the control program as exemplary embodiments of the present invention, the system parameter and the control program of a surveillance system can be automatically set and updated by installing a medium having stored the system parameter and the control program or by connecting the monitor system to a communication line for the installation of the system parameter and the control program. Consequently, the user need not repeatedly conduct the same setting and update operation and mistakes of humans can be avoided. It is therefore possible to provide a highly reliable surveillance system. In addition, the surveillance system of the present invention also leads to such advantage since the system parameter and the control program can be automatically set and updated.

CLAIMS

1. A continuous recording system, comprising:

removable recording medium drive;

a fixed disk unit connected to said removable recording medium drive; and

a controller connected to said removable recording medium drive and said fixed disk unit, wherein

said controller controls operation such that data is inputted to said removable recording medium drive an is recorded in removable recording medium of said removable recording medium drive; an input of said data is changed, when said removable recording medium is replaced with a new removable recording medium, from said removable recording medium to said fixed disk unit and the data is recorded on a fixed disk of said fixed disk unit; and the data recorded on said fixed disk is transferred, after said removable recording medium is replaced, to said new removable recording medium, thereby continuously recording the data.

2. A continuous recording method, comprising:

the first step of inputting data to removable recording medium drive and recording the data in removable recording medium of said removable recording medium drive;

the second step of changing an input of the data from said removable recording medium drive to said

fixed disk unit before an available memory capacity of said removable recording medium is used up and recording the data on a fixed disk of said fixed disk unit;

the third step of changing the input of the data, after said removable recording medium is replaced, from said fixed disk unit to said removable recording medium drive, recording the data in a new removable recording medium thus replaced, reserving a data path from said fixed disk unit to said removable recording medium drive, and copying the data recorded on said fixed disk onto said removable recording medium; and

the fourth step of interrupting, after the data recorded on said fixed disk is entirely copied onto said removable recording medium, the data path from said fixed disk unit to said removable recording medium drive while keeping the input of data to said removable recording medium drive reserved, wherein

control of process is returned to said first step to repetitiously execute processing.

3. A continuous recording method, comprising:

the first step of inputting data to removable recording medium drive and recording the data in removable recording medium of said removable recording medium drive;

the second step of changing an input of the data from said removable recording medium drive to said

fixed disk unit before an available memory capacity of said removable recording medium is used up and recording the data on a fixed disk of said fixed disk unit;

the third step of reserving, after said removable recording medium is replaced, a data path from said fixed disk unit to said removable recording medium drive while keeping the input of data to said fixed disk unit reserved; and copying the data recorded on said fixed disk onto said removable recording medium in a time series fashion; and

the fourth step of changing the input of the data from said fixed disk unit to said removable recording medium drive after the data recorded on said fixed disk is entirely copied onto said removable recording medium, and interrupting the data path from said fixed disk unit to said removable recording medium drive, wherein

control of process is returned to said first step to repetitiously execute processing.

4. A surveillance system, comprising:

a surveillance camera;

a video decoder connected to said surveillance camera;

an image compressor/decompressor connected to said video decoder;

a video encoder connected to said image compressor/decompressor;

a display connected to said video encoder; and

a continuous recording system connected to said image compressor/decompressor, wherein

said continuous recording system comprises:

removable recording medium drive;

a fixed disk unit; and

a controller connected to said removable recording medium drive and said fixed disk unit, wherein

said controller controls operation such that image data from said image compressor/decompressor is inputted to said removable recording medium drive and is recorded in removable recording medium of said removable recording medium drive; an input of said image data is changed, when said removable recording medium is replaced, to said fixed disk unit and the image data is recorded on a fixed disk of said fixed disk unit; and the image data recorded on said fixed disk is transferred, after said removable recording medium is replaced, to a new optical disk thus replaced, thereby continuously recording the image data.

5. A digital recording method, comprising:

the step of storing digital data in a buffer at a video capturing interval equal to or less than a video recording interval set by a user and temporarily delaying the digital data; and

the step of recording the digital data which is stored in the buffer and which is delayed thereby on a storage medium at the video recording interval set by a user.

6. A digital recording method according to claim 5, wherein said video capturing interval is a minimum interval of time at which data can be recorded in the buffer.

7. A digital recording method, comprising:

the step of storing digital data in a buffer at a video capturing interval equal to or less than a first video recording interval set by a user in a first recording mode and temporarily delaying the digital data;

the step of recording the digital data which is stored in the buffer and which is delayed thereby in the first recording mode on a storage medium at the first video recording interval;

the step of changing operation from the first recording mode to the second recording mode; and

the step of recording the digital data stored in the buffer on the storage medium in the second recording mode, the digital data being stored before a point of time when operation is changed from the first recording mode to the second recording mode.

8. A digital recording method according to claim 7, further comprising the step of recording the digital data stored in the buffer on the storage medium in the

second recording mode after the recording mode change time at a second video recording interval shorter than the first video recording interval.

9. A digital recording method according to claim 7, wherein the video capturing interval is a minimum interval of time at which data can be recorded in the buffer.

10. A digital recording method according to claim 8 or 9, wherein the video recording interval is the video capturing interval.

11. A digital recording method, comprising:

the step of capturing digital data at a video capturing interval equal to or less than a first video recording interval set by a user in a first recording mode, conducting predetermined processing including compression for the digital data to create first compressed data, and storing the first compressed data in a buffer and temporarily delaying the first compressed data;

the step of delaying by the buffer the first compressed data stored in the buffer in the first recording mode and then recording the first compressed data on a storage medium at the first video recording interval;

the step of changing operation from the first recording mode to the second recording mode;

the step of creating second compressed data with an amount of data larger than that of the first

compressed data and storing the second compressed data in a buffer in the second recording mode; and

the step of delaying by the buffer the second compressed data stored in the buffer in the second recording mode and then recording the second compressed data on the storage medium.

12. A digital recording method according to claim 11, wherein said second compressed data recording step comprises recording the digital data stored in the buffer on the storage medium in the second recording mode after the recording mode change time at a second video recording interval shorter than the first video recording interval.

13. A digital recording method according to claim 11, further comprising the step of recording the digital data stored in the buffer on the storage medium in the second recording mode, the digital data being stored before the recording mode change time.

14. A digital recording system, comprising:

a controller for changing operation from the first recording mode to the second recording mode;

a buffer connected to said controller for being controlled by said controller, for storing therein digital data at a video capturing interval equal to or less than a first video recording interval set by a user in the first recording mode, and for temporarily delaying the digital data; and

a recording device connected to said

controller for being controlled by said controller, for recording the digital data which is stored in said buffer and which is delayed thereby in the first recording mode on a storage medium at the first video recording interval, and for recording the digital data stored in the buffer on the storage medium in the second recording mode, the digital data being stored before a point of time when operation is changed from the first recording mode to the second recording mode.

15. A digital recording system, comprising:

a controller for changing operation from the first recording mode to the second recording mode;

a compressor connected to said controller for being controlled by said controller, for conducting predetermined processing including compression for the digital data, for creating first compressed data in the first recording mode, and
for creating second compressed data in the second recording mode, the second compressed data having an amount of data larger than that of the first compressed data;

a buffer controlled by said controller for storing therein the first compressed data and the second compressed data at a video capturing interval equal to or less than a first video recording interval set by a user, and for temporarily delaying the digital data; and

a recording device connected to said

controller for being controlled by said controller and for recording the first compressed data and the second compressed data which are stored in said buffer and which are delayed thereby on a storage medium.

16. A digital recording system according to claim 14 or 15, wherein said digital recording system is a surveillance system, further comprising an alarm connected to said controller for generating an alarm signal indicating a caution for a monitor region,

said controller changing the first recording mode to the second recording mode in response to the alarm signal.

17. A digital recording method, comprising:

the step of setting a first recording mode and a second recording mode;

the step of conducting predetermined processing including compression for digital data, creating first compressed data in the first recording mode, and creating second compressed data in the second recording mode, the second compressed data having an amount of data smaller than that of the first compressed data; and

the step of recording the first compressed data on a recording medium in the first recording mode and recording the second compressed data on a recording medium in the second recording mode.

18. A digital recording system, comprising:

a controller capable of setting a first

recording mode and a second recording mode;

a compressor connected to said controller for being controlled by said controller, for conducting predetermined processing including compression for digital data, for creating first compressed data in the first recording mode, and for creating second compressed data in the second recording mode, the second compressed data having an amount of data smaller than that of the first compressed data; and

a recording device connected to said controller for being controlled by said controller, for recording the first compressed data on a recording medium in the first recording mode, and for recording the second compressed data on a recording medium in the second recording mode.

19. A digital recording system according to claim 18, further comprising a detecting section for detecting a remaining amount of storage capacity of the recording medium, wherein

said controller is connected to said receives a detection result from said detecting section to change the first recording mode to the second recording mode according to the remaining amount of storage capacity of the recording medium.

20. A digital recording system according to claim 18, wherein said compressor is controlled by said controller and thins out predetermined data from the digital data in the second recording mode to thereby

create the second compressed data.

21. A digital recording system according to claim 20, wherein:

the digital data represents an image of a plurality of successive frames; and

the predetermined data is expressed in a unit of frames of the image.

22. A digital recording system according to claim 20, wherein:

the digital data represents an image of a plurality of successive frames;

each of the frames includes an array of a plurality of pixels; and

the predetermined data is expressed in a unit of pixels.

23. A digital recording system according to claim 18, wherein said compressor is controlled by said controller and uses a compression ratio in the second recording mode, the compression ratio being higher than that used in the first recording mode.

24. A digital recording method, comprising:

the step of compressing digital data representing an image to create compressed data;

the step of recording the compressed data on a recording medium; and

the step of changing an amount of data of the digital data per unitary time during said recording step.

25. A digital recording method, comprising:

the step of compressing digital data to create compressed data;

the step of recording the compressed data on a recording medium; and

the step of changing a compression ratio to be used in the compression of the digital data during said recording step.

26. A digital recording method according to claim 25, wherein said changing step includes changing the compression ratio before compression to a compression ratio after compression, the compression ratio after compression being less than the compression ratio before compression.

27. A surveillance system, comprising:

a surveillance camera;

a video decoder connected to said surveillance camera for converting analog data outputted from said surveillance camera into digital data;

an image compressor connected to said video decoder for conducting predetermined processing including compression for the digital data;

a recording device connected to said image compressor for recording the compressed digital data compressed by the image compressor on a recording medium; and

a controller connected to said image

compressor and said recording device, wherein:

said controller controls said image compressor to generate first compressed data in a first recording mode and second compressed data in a second recording mode, the second compressed data having an amount of data less than that of the first compressed data; and

said recording device records the first compressed data on a recording medium in the first recording mode and the second compressed data on the recording medium in the second recording mode.

28. A surveillance system according to claim 27, wherein:

said image compressor captures, in response to a capturing command sent from said controller, the digital data from said video decoder and compresses the digital data; and

said controller controls the capturing command to thereby control an amount of data per unitary time of the digital data captured by said image compressor.

29. A surveillance system according to claim 27, further comprising a frame buffer connected to said image compressor for temporarily storing therein the digital data before the digital data is compressed by said image compressor, wherein:

said image compressor reads, in response to a readout command sent from said controller, the digital

data from said frame buffer and compresses the digital data; and

said controller controls the readout command to thereby control an amount of data per unitary time of the digital data.

30. A surveillance system according to claim 27, further comprising input means for requesting a user of said surveillance system to supply an input indicating whether or not the second recording mode is to be used.

31. A surveillance system according to claim 27, further comprising a detecting section for detecting a remaining amount of storage capacity of the recording medium, wherein

said controller is connected to said detecting section, receives a detection result from said detecting section, and automatically uses the second recording mode when the user does not supply an input to said input means before the remaining amount of storage capacity of the recording medium becomes equal to a predetermined value.

32. An image compression/decompression system, comprising:

a detecting circuit for subdividing first image information into areas each of which has a predetermined size and for detecting a maximum value of an image change rate per unitary distance for each of the areas;

a lowpass filter for conducting predetermined

filter processing for the first image information in the area having the maximum value exceeding a threshold value; and

a JPEG codec for compressing second image information including the first image information in the area having the maximum value equal to or less than the threshold value and the first image information passed said lowpass filter, by conducting a DCT operation for the second image information.

33. An image compression/decompression system according to claim 32, further comprising a JPEG file processor for writing, in a comment marker, file data including identifier information of the area having the maximum value equal to or more than the threshold value, differential information between the maximum value and the threshold value, and the threshold value information and for thereby creating a JPEG file together with a compressed data string outputted from said JPEG codec.

34. An image compression/decompression system according to claim 32, further comprising:

a filter data analyzing circuit for receiving and analyzing the filter data including identifier information of the area having the maximum value equal to or more than the threshold value, differential information between the maximum value and the threshold value, and the threshold value information; and

a peaking filter for receiving the image

information created by said JPEG codec and conducting predetermined filter processing, according to a result of the analysis by said file data analyzing circuit, for the area having the maximum value exceeding the threshold value.

35. An image compression/decompression system according to claim 34, wherein said detecting circuit, said lowpass filter, said file data analyzing circuit, and said peaking filter are integrally constructed as one digital signal processor.

36. A surveillance system, comprising:

a surveillance camera;

a video decoder connected to said surveillance camera;

an image compression/decompression system connected to said video decoder;

a video encoder connected to said image compression/decompression system; and

a display connected to said video encoder, wherein:

said image compression/decompression system comprises:

an input filter connected to said video decoder;

a JPEG codec connected to said input filter; and

a JPEG filter processor connected to said input filter and said JPEG codec,

said input filter includes:

a detecting circuit for subdividing first image information into areas each of which has a predetermined size and for detecting a maximum value of an image change rate per unitary distance for each of the areas; and

a lowpass filter for conducting predetermined filter processing for the first image information in the area having the maximum value equal to or more than a threshold value,

said JPEG codec compresses second image information including the first image information in the area having the maximum value less than the threshold value and the first image information passed said lowpass filter, by conducting a DCT operation for the second image information, and

said JPEG file processor writes, in a comment marker, file data including identifier information of the area having the maximum value equal to or more than the threshold value, differential information between the maximum value and the threshold value, and the threshold value information, and thereby creates a JPEG file together with a compressed data string outputted from said JPEG codec.

37. An automatic setting and update method for system parameters of a surveillance system, comprising:

the step of making a check to determine whether or not there exists a first system parameter

currently being used in the surveillance system and whether or not a second system parameter to be introduced to the surveillance system is younger than the first system parameter;

the step of automatically setting, when it is determined that the first system parameter does not exist in the surveillance system, the second system parameter to the surveillance system by copying the second system parameter thereonto;

the step of automatically updating, when it is determined that the first system parameter exists in the surveillance system and the second system parameter is younger than the first system parameter, the first system parameter to the second system parameter; and

the step of keeping the first system parameter when it is determined that the first system parameter exists in the surveillance system and the first system parameter has a creation day equal to or younger than a creation day of the second system parameter.

38. An automatic setting and update method for system parameters in accordance with claim 37, further comprising the step of confirming, before said determining step, identifier (ID) data regarding the second system parameter to be introduced.

39. An automatic setting and update method for system parameters in accordance with claim 37, wherein:

the first system parameter includes a flag

for allowing update of the first system parameter;

said method further comprising the step of making a check to determine whether or not the flag allows update of the first system parameter; and

said update step includes updating the first system parameter when it is determined that the flag allows the update.

40. An automatic setting and update method for system parameters in accordance with claim 37, wherein:

the first system parameter sets a plurality of operation environments and includes a flag for allowing update the first system parameter for each of the operation environments;

said method further comprising the step of making a check to determine whether or not the flag allows update of the first system parameter; and

said update step includes updating the first system parameter for operation environments for which it is determined that the flag allows the update of the first system parameter.

41. An automatic setting and update method for system parameters in accordance with claim 37, further comprising the step of accessing, before said determining step, a predetermined address to download the second system parameter via a communication line.

42. An automatic setting and update method for control programs of a surveillance system, comprising:

the step of making a check to determine

whether or not there exists a first control program currently being used in the surveillance system and whether or not a second control program to be introduced to the surveillance system is younger than the first control program;

the step of automatically setting, when it is determined that the first control program does not exist in the surveillance system, the second control program to the surveillance system by copying the second control program thereonto;

the step of automatically updating, when it is determined that the first control program exists in the surveillance system and the second control program is younger than the first control program, the first control program to the second control program; and

the step of keeping the first control program when it is determined that the first control program exists in the surveillance system and the first control program has a creation day equal to or younger than a creation day of the second control program.

43. An automatic setting and update method for control programs in accordance with claim 42, further comprising the step of confirming, before said determining step, identifier (ID) data regarding the second control program to be introduced.

44. An automatic setting and update method for control programs in accordance with claim 37, further comprising the step of accessing, before said

determining step, a predetermined address to download the second control program via a communication line.

45. A surveillance system, comprising:

a surveillance camera for shooting an object and for outputting an electric analog signal;

a converter section for converting the electric analog signal into a digital signal; and

a controller for recording and editing the digital signal, wherein said controller comprises:

a storage for storing therein system parameters for setting an operation environment of said surveillance system and control programs for controlling said respective sections of said surveillance system; and

a controlling section for controlling automatic setting and update of the system parameters and the control programs.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP99/05922

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl^7 G11B20/10, H04N5/915

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int.Cl^7 G11B20/10, H04N5/915

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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Kokai Jitsuyo Shinan Koho	1971-2000	Jitsuyo Shinan Toroku Koho	1996-2000

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	JP, 7-201130, A (Sony Corporation), 04 August, 1995 (04.08.95),	
Y	Full text; Figs. 1 to 4	1-3
A	Full text; Figs. 1 to 4 (Family: none)	4
A	JP, 9-46636, A (Sanyo Electric Co., Ltd.), 14 February, 1997 (14.02.97), Full text; Figs. 1 to 3 (Family: none)	5-10
A	JP, 10-108163, A (Sony Corporation), 24 April, 1998 (24.04.98), Full text; Figs. 1 to 4 (Family: none)	11-23, 27-31
A	JP, 6-165155, A (Sony Corporation), 10 June, 1994 (10.06.94), Full text; Figs. 1 to 21 & WO, 94/08427, A1 & CN, 1090455, A & EP, 614592, A1 & AU, 669209, B2 & US, 5559557, A	24-26

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
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Date of the actual completion of the international search 18 January, 2000 (18.01.00)	Date of mailing of the international search report 25 January, 2000 (25.01.00)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP99/05922

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP, 6-343167, A (Sanyo Electric Co., Ltd.), 13 December, 1994 (13.12.94), Full text; Figs. 1 to 4 (Family: none)	32-36
A	JP, 7-225687, A (Eastman Kodak Japan K.K.), 22 August, 1995 (22.08.95), Full text; Figs. 1 to 4 & EP, 667622, A2	37-45